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THE SARATOGA CONVENTION.

Although this is an early and, in many respects, inconvenient season of the year for street railway men to get together, the meeting of the American Street Railway Association at Saratoga Springs during the current week has been a far greater success than those interested dared hope. After all, there are advantages in holding a convention, sometimes, away from the distractions of a great city; and as this is the end of the Saratoga season, when the racing is all over and the fashionable crowd has flitted, the street railway men have been able to stick to business, with little to tempt them away. Hence, while the attendance has been large, and the exhibition of apparatus well up to the standard, the papers and discussions have been quite superior to the average.

It will be interesting to note in the future how far the division of the convention work between three bodies meeting at or about the same time, affects the relative importance of each. While we do not believe that the standing and influence of the parent national body will suffer in any way, it does seem to us that the work of the new engineering body will steadily gain in recognition and put it on a high plane. The technique of the art is, indeed, one of its most vital considerations, and we are glad to see the mechanical and electrical association—to use only part of its long name—start out so seriously and effectively to make a record for itself. Indeed, the excellence of such work must prove a stimulus to the ambition of the other bodies, and these in turn by their wise dealing with the broad topics of the industry, and with its finances, will help impress on the electrical engineers and the master mechanics the value and significance of every attempt to improve or standardize methods and materials. No branch of the industry can stand alone; all are of the greatest importance for its development; and the annual convention with its free and frank discussion of problems and difficulties is the best way known as a supplement to the publicity of the press in securing an equable advance all along the line.

STATISTICS OF THE AMERICAN ELECTRIC LIGHT INDUSTRY.

There is a satisfactory substantiality in statistics that appeals to the argumentative mind, especially when the statistics and the arguments are on one and the same side. But woe betide the inferences that rest upon the sands of incorrect or imperfect statistics. It is the first duty of all good statistics to be impartial, and the second duty to be complete, and not fragmentary. We published recently, at page 212, the summary of an important series of statistics issued in a preliminary report from the United States Census Office, concerning the electric light and power central station industry in the United States. These are certainly the most complete and trustworthy data that have yet been published on the status of that industry, and as such we have already commented on them. They convey, moreover, a number of inferences on the subject of municipal electric lighting that are more valuable than all the tirades which have been launched on either side of this much-vexed question. They show that nearly one plant in four (22.5 per cent) of all the lighting plants (excluding isolated plants) in the United States, is a municipal plant. But whereas the average cost of a private plant is about $170,000, the average cost of a municipal plant is $27,000. This means that the average private plant is about six times as large as the average municipal plant, and also that whereas the

number of municipal plants is 22.5 per cent of the total, the cost of municipal plants is only 4.4 per cent of the total cost.

In regard to gross income, the data show that the private plants average 16.3 per cent on their cost, and the municipals average 31.6. In this respect the municipals give apparently nearly double the return of the privates, per dollar invested. In total expense of operation the privates show an average of 13 per cent on their cost, and 65 per cent of their gross income, while the municipals show an average of 24 per cent on their cost, and 68 per cent of their gross income. Consequently, in regard to investment, the municipals are nearly twice as expensive as the privates; but in regard to gross income, the relative expense of operation is much the same. The wages per horse-power of installed plant comes out very nearly the same for both types, being nearly $12 per horse-power per annum. This indicates that the cost in wages of municipal plants is sensibly the same as that of private plants. The cost of supplies for local companies is about $12.50 per horse-power per annum, and for the municipals about $15.30, indicating that the municipal plants are, relatively, decidedly more expensive in materials. This, however, may be explained, at least in part, by the small average size of the municipal dynamos, which is 83.5 hp; while the average size of the private dynamos is nearly twice as large, or 137 hp. The items of taxes and building rent are relatively too low for the municipal plants, and indicates that the costs both of installation and of operation are somewhat unduly magnified in private plants, owing to their having to carry the full burden of these items, from which the municipals are represented as almost exempt. It is not fair to charge taxes against private plants and to charge no taxes against municipals.

The municipal plants carry about 13 per cent of the total arc lamps, and about 9 per cent of the total incandescent lamps, showing that municipal arc-lighting is distinctly more in vogue than municipal incandescent lighting. The total horse-power in municipal dynamos is just about 10 per cent of the total horse-power in private dynamos. This is probably the fairest basis of comparison between the two types of plants. The private plants work their dynamos distinctly harder, averaging 5.6 hours daily per kilowatt of generated capacity, against 4.75 for the municipals. This is perhaps accounted for by the greater share of short-hour arc-lighting carried on by the municipals. The latter virtually operate their machines under full load for one hour daily less than the privates.

The average salary to officials and clerks is $860 per annum for private plants, and $482 per annum for municipals. This means that the average private central station officer is nearly twice as highly paid as the average municipal officer. As regards wages to workingmen, the comparison is more nearly uniform, being $650 per annum for private plants and $575 per annum for municipals. Assuming that the statements filed with the Census Office are reliable, they explode the theory that municipal plants are always operated more extravagantly than private central stations; but the trouble lies in the vagueness of municipal figuring. So far as wages are concerned, the reverse appears to be the case. The figures indicate that the average municipal plant is, in general, a comparatively small arc-lighting plant, operated without extravagance, under the watchful eyes of a small community. Each dollar expended in labor produces 120 kw.-hours per annum from the private plants and 104 kw.-hours per annum from the municipal plants. This is not a very large disparity, especially if the relative sizes of plants be considered. Considered in another way, it also means that the cost of wages and superintendence in both types of plants is not far from one cent per kw.-hour (0.85 cent). At this rate we may reasonably expect municipal plants to increase both in number and in size, but, of course, the risk involved in their mismanagement increases as they become larger and occupy a more important place in municipal affairs. Moreover, it is mainly in large cities that the danger of mismanagement through political influences is greatest. A single year of mismanagement of any mechanical plant may well bring about disastrous results in the way of depreciation and destruction.

In theory, it is a matter of very little consequence whether the electric lighting of a community be conducted by a select few of their body under the title of a corporation, or by the same men under the badge of that larger corporation called a municipality. Incidentally and practically, however, the difference is apt to be considerable. The adoption of a certain line of industry by a government or municipality is apt to be subversive of competition, and of the improvements which competition develops. On the other hand, there are possibilities for economy when the governing body operates a large business, which the ordinary corporation does not possess. Again, the modern municipal lighting plant, if it does other than plain arc lighting, calls for the exercise of considerable technical skill, and political methods may be fatal to the selection of men adequate to the task. For these reasons the question of municipal electric lighting is one of the most interesting sociological questions of the day. The census data show that the municipal plants employ 10.7 per cent of all the steam power used in central station lighting, but only 3 per cent of all the water-power so used. This may mean that municipalities have not yet seriously undertaken the transmission of water power. Of constant potential dynamos expressed in kilowatt capacity, both alternating and direct, the municipal plants have 8 per cent, while of the constant-current dynamos they have 19.3 per cent, a disparity which again indicates the tendency towards the easier and limited arc-lighting in existing municipal central stations.

WIRELESS TELEGRAPHY IN ITS NATIONAL ASPECT.

We are pleased to be able to record that all reports of the naval and military manœuvers indicate that wireless telegraphy has proved a most successful arm of the information service. Last year, as our readers will remember, the wireless service played no part in the operations, and the attempts made to utilize it to a certain extent were abject failures. It is most gratifying to record the present improvement in the situation, both as evidence of the growth in the art and as proof that the naval and military authorities have finally awakened to the necessity of keeping up with the times. With the enormous extent of coast line to be guarded, the value of wireless telegraphy to the United States is, or ought to be, exceptionally great, but, as usual, the procrastination bureau is just a few laps behind in the race and has done this year what it should have done year before last. Every improvement in the material of war has been taken up here long after its importance has been acknowledged elsewhere, and thus wireless telegraphy is in nowise exceptionally treated. We hope that the advent of General Staff methods will result in greater promptness in taking up various improvements, and in particular that the wireless service will be systematically developed, not only for coast guard work, but for general communication between military and naval posts. This latter use might conceivably be of enormous importance. It is utterly absurd for the military communications of the government in time of need to be dependent entirely on the overhead wires of private corporations, even temporarily. However loyally such corporations may subordinate their service to government necessities, the mere chance of fatal

interruption of wires is reason enough for an independent system of communications.

If the government is to take up wireless telegraphy as it should for the purposes of national defense, it is absolutely necessary that it should be possible to prevent casual or wilful interference with government messages. If this end can be reached by some method of working we do not see anything feasible, save governmental control of the whole wireless situation. The recent conference abroad looking to international regulation of wireless telegraphy was a very necessary step, and unless the rival systems can or will abstain from interfering with each other they will undoubtedly feel the heavy hand of the government in a way that will be distinctly unpleasant. In short, the syntonic bluff is in a fair way to be called. The possibility of non-interference has been loudly and insistently proclaimed by the advocates of all the wireless systems; it has been attested by engineers who ought to know the facts, and yet when put to the test of trial interference seems to be painfully in evidence. If it can be effectively suppressed it is "up to" the wireless gentlemen to suppress it without further delay. If it cannot be suppressed then the necessities of national defense, in this country and elsewhere, will compel united action to preserve the integrity of the military and naval communications. We believe that this question of interference is of so fundamental commercial importance, so far transcending all the other problems in hand, that until it is settled wireless telegraphy will make very slow progress. It is of no particular importance to establish a trans-Atlantic service if it is to result in crippling coastwise service, or is to be demoralized by any rival experimenter who sets up shop within a few hundred miles of the termini. Long-distance wireless telegraphy is indeed a splendid achievement, but it is fruitless unless serviceable all day and every day, and free from accidental or malicious interference. And to comment on another phase of the wireless telegraph situation, it is indeed a pity that one of the finest discoveries of the age has become, through the manner in which it is exploited commercially and the utterly undignified squabbles to which it gives rise, a subject with which the public is getting heartily disgusted.

MAGNETIC FLUX SIFTERS.

An interesting principle in rotary field alternating current transformers as applied by M. Maurice Leblanc to the problem of current rectification is described in a recent issue. The fundamental problems may be stated under various forms. Thus, given an alternating-current e.m.f. of an irregular, or complex-harmonic type, it is required to transform it into an e.m.f. of the simple harmonic type. Or, required a transformer which when supplied with a complicated wave of alternating e.m.f. at its primary terminals, shall deliver a simple alternating wave of e.m.f. at its secondary terminals. Or, required a transformer which shall sift out harmonics from the current it delivers. The simple alternating-current wave is the type to which designers of alternating-current machinery tend to follow. It is not only the simplest in computation, but is also the simplest in operation. It is true that the alternating-current transformer consumes less energy in hysteresis when supplied by peaked e.m.f. waves, than when supplied by sinusoidal waves, other things being equal; but, on the other hand, the sinusoidal wave is easier to rectify, and easier to transmit to long distances. Near the beach, and over shallow water, the ocean waves are sharper-peaked, but over the great expanses, and for long distance transmission, the ocean swell is sinusoidal in profile. In the rotary-field magnetic circuit, harmonic magnetic fluxes circulate with different speeds. If the fundamental flux rotates with a speed of, say, six revolutions per second, the triple harmonic flux rotates with a speed of eighteen revolutions per second, the quintuple harmonic flux rotates with a speed of thirty revolutions per second, and so on. Hence traps can be set to catch the higher-speed fluxes, while the fundamental travels undisturbed.

In the case considered, the transformer behaves as though it had a short-circuited secondary winding for the harmonics. The compensating secondary windings act like short circuits to all frequencies above the fundamental, and have no effect on the fundamental. In the closed voltaic circuit, the principal law is that the total electromotive force in the circuit, including potential difference, must be equal to zero. That is to say, the algebraic sum of the electromotive forces, plus the drops of pressure due to current flow, must be equal to zero. In the magnetic circuit the principal law is that the total magnetomotive force in the circuit must be equal to zero, including potential difference. That is to say, the total number of ampere-hours, including the drop of gilbertage, due to magnetic flux traversing the reluctance of the circuit, must be equal to zero. Consequently, in a short-circuited transformer receiving a constant primary current, and therefore a constant primary magnetomotive force, the secondary ampere-turns adjust themselves automatically into equality of magnitude and opposition of phase with the primary ampere-turns, so that the resulting magnetomotive force is practically nil. The power absorbed from the primary circuit is confined to the losses of power in the copper and iron of the transformer. Similarly, if a transformer be provided with two separate secondary windings, one of which is short-circuited, while the other is connected to a secondary circuit, the former will absorb the entire primary m.m.f., and no appreciable power will be developed in the latter.

The transformer in question virtually provides short-circuited secondary windings for the harmonic frequencies, and a non-short-circuited or working secondary winding for the fundamental frequency. By this means the magnetomotive force of the harmonic current components is neutralized by the short-circuiting currents, without sensible waste of power, while the magnetomotive force of the fundamental current, which is, of course, sinusoidal, is left free to be neutralized by the working secondary sinusoidal current. This working sinusoidal current absorbs power from the primary circuit. The resulting arrangement constitutes a harmonic sifter. The harmonic magnetic fluxes are not suppressed in the magnetic circuit, but only modified in phase. They are, however, confined in their operation to producing secondary magnetomotive forces that are almost devoid of power; since they produce a certain number of amperes and ampere-turns in short-circuited windings that have but little resistance. Incidentally, the principle is sought to be applied to a converter of the non-rotary type. This machine is provided with a closed magnetic circuit, although the magnetic flux rotates. The brushes for the direct-current delivery also rotate at synchronous speed, and for adjustment of the direct e.m.f., the poles of the brush-driving motor are shifted mechanically.

If such a type of current-rectifier could be successfully developed in large sizes, there would be considerable advantage in having the windings and magnetic cores all stationary, and no moving parts except the brushes. With such rectifying machinery in general use, the term "rotary converter," which is now supererogatory, would be almost rendered necessary. The term "converter," which is now sufficient to define machines with rotating armatures for converting alternating currents to direct currents would no longer be adequate. A condenser, or a choking coil, serves in the voltaic circuit to sift out alternating currents from continuous currents. The principle above discussed serves in the magnetic circuit to sift multiple frequency fluxes from the fundamental.

Mr. Westinghouse on the Third Rail.

The *New York Times* of Sept. 1 prints a letter over the signature of Mr. George Westinghouse, which is reproduced in full below:

"The public as well as those financially interested in the development of electric traction should feel indebted to the *Times* for its thoughtful editorial articles on the recent Paris underground electric railway accident in which it makes doubly clear by quoting Mr. Yerkes that combustible materials should be avoided, particularly in train construction and in station work of underground and elevated railways.

"I agree with the *Times* that the lessons to be drawn from this accident are important, and believe they will lead to the adoption of apparatus and methods which ought to make an electrically-propelled train as safe as one drawn by a steam locomotive, and thus insure a realization of the great advantages of the former.

"The supreme importance of the subject prompts me to again urge such a revision in the heretofore accepted plans as will insure safety to passengers and employees, as well as the avoidance of ultimate great losses to companies operating electric railways.

"It will be recalled that, following the collision between steam-propelled trains in New York City in the Fourth Avenue tunnel on the New York Central Railroad in January, 1902, involving great loss of life due to escaping steam, there was an exciting discussion of the event, with a widespread expression of a belief that had such trains been operated by electricity there would have been no loss of life; and for days almost the entire press of New York devoted columns to the subject and urged prompt legislation which would compel the New York Central Railroad Company to use electricity instead of steam for the operation of its trains within the city tunnels.

"Having had a long experience in matters pertaining to the safe working of railway trains and having acquired a very considerable knowledge of the power and peculiarities of electricity, I believed I might do a public service by drawing attention through the press to the elementary fact that the electric operation of trains could not lessen some of the risks, but might, on the contrary, add new ones of a serious character, and I therefore wrote a letter which you published in your columns at the time, and which has recently been extensively republished.

"That letter was criticized favorably by some, but was belittled and denounced by interested parties as calculated to impede the introduction of electricity for traction purposes.

"Since then as a result of that discussion, there have undoubtedly been great improvements demanded and made in the character of electrical apparatus for railway use; but as often happens, it has required an awful experience to bring home to those charged with the responsibility of guarding against railway accidents the fact that there is no margin for use in tunnels of combustible material in proximity to a heavily-charged electric conductor.

"The recent injury to a number of workmen engaged upon the elevated railway is only another illustration of the need for a revision of the plans which have heretofore prevailed and which have evidently been regarded by many railway officials as reasonably safe.

"The realization of the great cost of such an accident as the recent one in Paris, regardless of the horror of it, will undoubtedly cause the plans already decided upon to be most carefully reviewed, and should bring to the officials of the companies interested the highest skill in determining the requirements, the compliance with which will render the carrying of passengers on trains operated by electricity as safe at least as if propelled by other means.

"It seems almost axiomatic that the third rail should only be charged with electricity when required to operate a train; that there should never be more electric energy at any point of a third rail than sufficient to operate one train; that the electric machinery required upon a train should be reduced to a minimum, and should be so located as to be under the convenient supervision of the train attendants; and in all tunnel and elevated railroad work there should be no material to create fire or dense smoke.

"The following requirements, among others, can easily be complied with, and are respectfully suggested for consideration and discussion:

"1. Trains to be constructed of iron or steel, with the interior finish of incombustible materials. 2. The division of the third rail for the supply of electric current into suitable sections, each section being supplied with current only when required to propel a train. 3. The limitation, by suitable devices, of the amount of current supplied to each section, so that in the event of a short-circuit on the train the current will be automatically and instantaneously cut off at a point some distance from such section of the third rail. 4. Provision for the cutting off of the current from each supply section of the third rail at the will of the motorman. 5. No other live conductors than the third rail to be in close proximity to the line. 6. No wires carrying high voltages except upon motor cars, and motor cars only at the ends of a train.

"The state of the electric art has so advanced that compliance with the foregoing requirements is simply a matter of additional expense, incomparable, however, to the financial losses which the companies will suffer if they do not make the electric operation of their railways absolutely safe.

"Believing the foregoing requirements can be complied with, I have read with amazement the opinions quoted in your Friday's issue under the heading: "No Device to Stop Third-Rail Killings." I am sure Mr. Hedley must have been misquoted in regard to the possibility of collisions due to the temporary shutting off of the current from the third rail, for, as a matter of fact, the stopping of the trains on the elevated railway is not in the slightest degree affected by the temporary cessation of the current on the third rail.

"It is true, however, that the system of train control in use upon the elevated road, and which has been ordered for the rapid transit trains, is so organized that its correct operation is dependent upon a constant supply of current to the third rail, and that therefore the division of the third rail into sections and the temporary supply of current only as needed, might, with the existing system of train control, be inoperative; but there are available well-tried controls which are operative regardless of a temporary interruption in the supply of current.

"It is well and sorrowfully recognized by our great railway engineers that early mistakes, due to inexperience, in the dimensions adopted for tunnels, gauge of track, and in the method of coupling cars have established practices which cannot now be escaped from because of the necessity for a uniform practice, in the points cited, on connecting railways.

"The advantages to accrue from this necessity for uniformity in railway practice to that concern which can secure the adoption of its plans covered by patents has led to a commercial rivalry, the influence of which for evil cannot well be appreciated. This intense rivalry between the two great electric manufacturing companies of the country, each enjoying the same rights under numerous patents, has undoubtedly led to a great improvement in the electric art, but to that rivalry, where none should exist, can also be attributed much of the cause for the present alarm concerning the unsatisfactory method of electric operation of trains.

"If, therefore, a frequently-adopted practice be adhered to, viz.: that having already expended a large sum for electric plant and equipment of a certain character, there must hereafter be used for extensions and upon connecting lines only such apparatus and methods as will fit in with the existing plans, however imperfect they may be, then there is small hope for a safe system of electric traction.

"The most recent accident on the Paris underground railway, where passengers were frightened and jumped from the train, illustrates how necessary it is to so install electric apparatus that there can be no such alarming occurrences.

"Being sure of my ground and of the necessity for public pressure in securing the desired reforms, and with a full belief that electric traction can be made safe, I am, respectfully yours," [Signature.]

In commenting on the letter, the *Times* says that Mr. Westinghouse touches upon one difficulty, the remedy for which is not easily found. "That is the absence of anything approaching standardization in electrical equipments, and the fact that when one patented system is adopted, however defective experience may show it to be, additions and extensions must be made in conformity with it, thus in some degree blocking the way for progress in the direction of as complete provision for safety as the advancing state of the art might permit. This points in a direction which may mean the extinction of existing commercial rivalries in the manufacture of electrical appliances—something difficult of accomplishment while valuable basic patents remain vital and operative. The progress is toward standardization in electrical equipment, but the ultimate is not likely to be attained as long as the field is divided between two controlling concerns in sharp and active competition. If the suggestion of Mr. Westinghouse foreshadows the merger of his interests and the interests of the General Electric, it will be of great moment to a great many people."

Central Avenue Power Station, Kansas City, Kan.

BY H. S. BADGER AND G. E. SCHREIBER.

AMONG the recent installations of power plants in the West is the Central Avenue Power Station of the Consolidated Electric Light & Power Company, of Kansas City, Kan. By reason of its size and modern equipment in both the mechanical and electrical features, a detailed description of the plant will no doubt prove of interest to central station engineers.

The plant was designed and equipped to furnish light and power

FIG. 1.—VIEW OF EXTERIOR OF POWER STATION.

to Kansas City, Mo., and Kansas City, Kan. As far as electric service is concerned these two cities are one community, for a busy thoroughfare forms the artificial division line between the two cities.

At the time of the inception of the Central Avenue Station the power and lighting service for these two cities was supplied by a number of scattered stations, which, owing to the continually increasing demand for light and power, were unable to economically supply the service; thus the Central Avenue Station as a central power station was designed to supplant these scattered stations.

This was the purpose for which the plant was originally designed, but before its completion, by an agreement between the Consolidated Electric Light Company and the Metropolitan Street Railway Com-

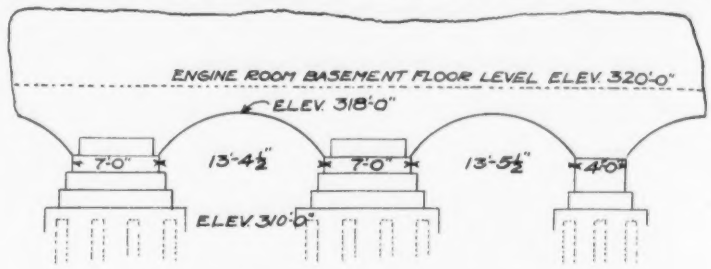


FIG. 3.—FOUNDATIONS OF POWER STATION.

pany, of Kansas City, Mo., necessary changes, to be explained later, were made in the switchboard equipment, so that besides supplying lighting and power service, power is furnished for the rotary substations of the Metropolitan Company, for their street railway service. In consequence of this agreement some of the old power stations will continue in operation until the completion of an immense plant now being built by the Metropolitan Company, and to be known as the Missouri River Power Station.

BUILDING.

The site of the Central Avenue Power Station is on the east bank of the Kaw or Kansas River, where water for condensing purposes is at hand on one side and convenient railway facilities are on the other. The superstructure of the building is of steel frame and brick construction, and the foundation walls are of concrete. The exterior appearance of the building is plain, the general design being shown in Fig. 1. The general dimensions of the building between the steel columns are 117 ft. 10 in. x 172 ft. A curtain wall divides the building into two main compartments, the engine room and the boiler room, the former being 60 ft. x 17 ft., with a height under the roof truss of 51 ft. and the latter 55 ft. x 171 ft., with a height of 30 ft. under the roof truss.

Owing to the alluvial soil of the bank, the foundation walls are supported on piling in order to secure a firm and solid foundation. The piles were driven to a depth of about 40 ft. in groups directly under the places

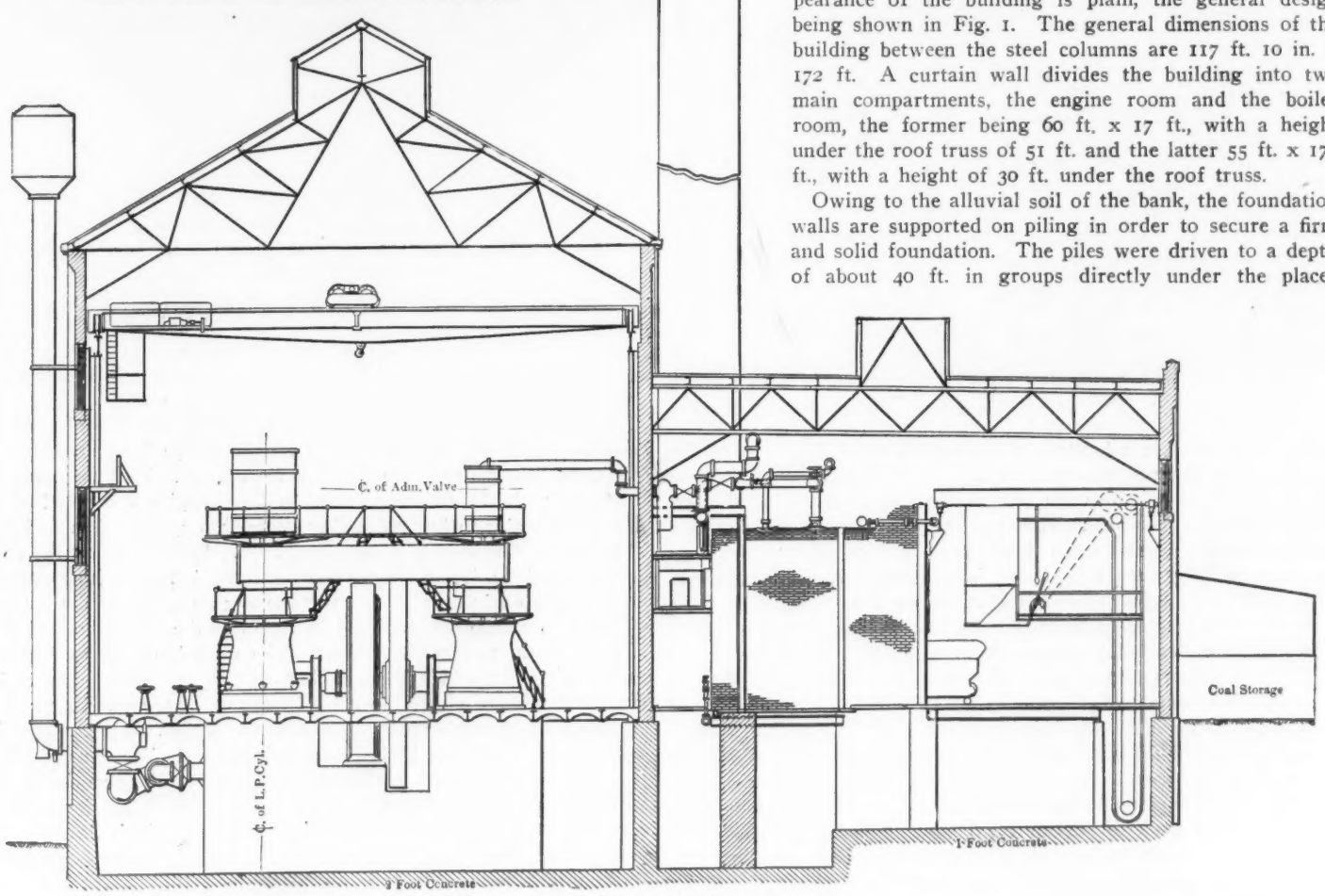


FIG. 2.—CROSS-SECTION OF POWER STATION.

at which the steel columns were to rest on foundation walls. The lower portion of the foundation walls is a series of arches whose

abutments rise from the several groups of piling. Fig. 3 is an elevation of a portion of the foundation walls clearly showing the manner in which the walls start from the piling. The tops of the arches are two feet below the engine room basement, whose elevation is 320 ft. The foundation walls are built up to elevation 336.5, which is 18 in. below the engine room floor level. From this elevation the steel work and brick superstructure starts.

The boiler and engine room floors are at the same level. Only that portion of the boiler room basement floor back of the ash pits is down to the same level, as the engine room basement floor. The portion of the boiler room basement in front of and to the back of the ash pits is 4 ft. 3 in. above this level. This difference in level in the boiler room basement was made to provide for a future installation of economizers back of the ash pits.

The engine room and boiler room floors are of expanded metal, concrete and steel I-beam construction. Only that portion of the floors in engine and boiler rooms around the present apparatus has been installed, thus leaving large wells in both rooms, which space will be taken up by future installations.

All of the auxiliary steam apparatus, excepting the feed water heater and boiler feed pumps, which are placed on a wing of the boiler room floor, are located on the engine room basement on the north side of the present engine foundations. On the opposite side of the engine foundations are located the transformers, oil switches and high-tension bus-bars. The steam engine, which is belted to the exciters on the engine room floor above, is located near the west building wall between the engine foundations. A Whiting three-motor, 30-ton, electric traveling crane spans the engine room, and it travels the whole length of same. The crane runways are supported by the steel building columns.

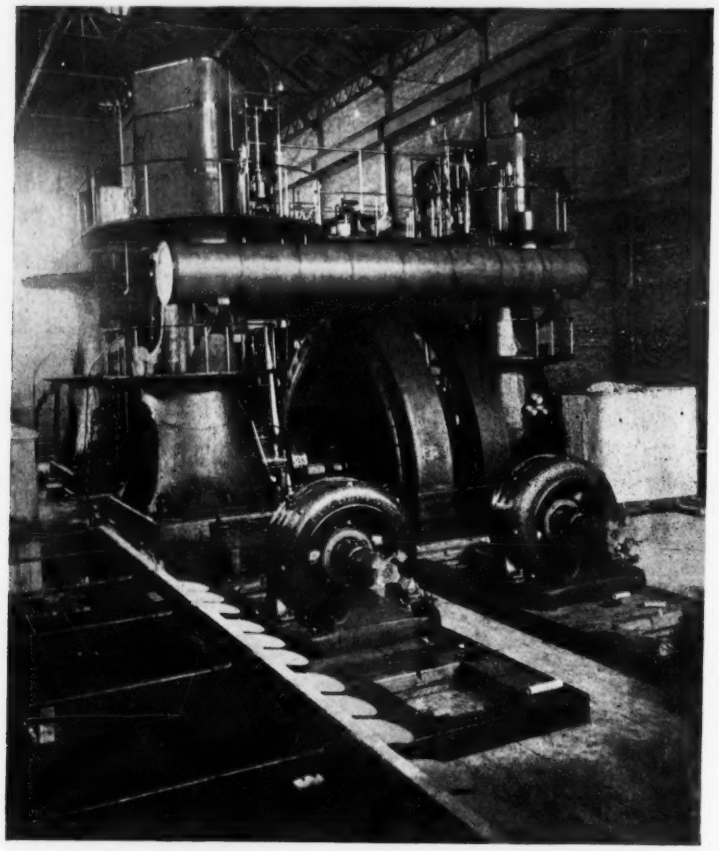


FIG. 4.—VIEW OF ENGINES FROM TOP OF SWITCHBOARD.

The foundations for the engines are built of concrete, resting on a continuous concrete base, which ties together the tops of piling. There are 206 piles under the base, driven 3 ft. 3 in. on centers. The foundations for condenser, air pumps, boiler supports and interior columns all rest on piling.

Two 1,500-kw, 6,600-volt, three-phase, 25-cycle generators have been installed, each direct-connected to a 2,250-hp Allis-Chalmers vertical cross-compound, condensing engine. Space has been reserved in the engine room for a 2,000-kw unit, as well as space in the boiler room for an additional battery. The low frequency of 25 cycles was chosen on account of its adaptability to motor and rotary converter service, which will be the greater part of the total load to be carried by the station. As this frequency is too low for satisfactory lighting, 2,300-volt, 60-cycle, two-phase generators, direct-connected to 6,600-volt, three-phase, 25-cycle synchronous motors are used to supply the lighting service.

MAIN GENERATORS.

The generators are of the revolving field type. The armature frame is of cast iron, so mounted that it can be moved parallel to the shaft into a position clear of the revolving field, leaving both the armature and field open for inspection, cleaning or repairing. On the revolving field the poles are attached by bolts to a steel ring carried on the field spider. The field coils are of copper ribbon, wound edgewise, and insulated by means of wooden collars at each end, and a wrapping of insulating fabric, on the poles. The fly-wheel effect of the revolving field is 58,000 foot-pounds at a radius of six feet. The tests and guarantees on the machines were as follows:

The insulation between the armature windings and armature core was subjected to a pressure of 13,200 volts alternating for one minute without piercing the insulation. This is just double the voltage of the generator. The insulation between the field winding and the core stood 1,500 volts alternating for one minute.

The temperature of any part of the machine as measured by a thermometer is guaranteed not to be more than 35° C. above that of the surrounding air after 24 hours run at rated load and speed, nor more than 55° C. after two hours run at 50 per cent. overload, provided that the temperature of the surrounding air does not exceed 25° C. In the event of the room temperature differing from 25° C. the observed rise in temperature is to be corrected one-half a degree for each degree Centigrade that the room temperature differs from 25° C.

The full load efficiency of the generators is 94.5 per cent., ¾ load, 93.5 per cent., and ½ load 91.5 per cent. The inherent regulation, that is the rise in potential when full non-inductive load at rated potential, is thrown off the machine, will not exceed 6 per cent., the speed and the field excitation remaining constant.

An idea of the general appearance of the engines can be obtained from Fig. 4, which shows a view taken from the top of switchboard. The reheating receiver rests on brackets attached to each frame. There are two galleries for each engine, the top galleries connecting between engines.

The diameters of the high and low-pressure cylinders are 34 in. and 70 in. respectively and the stroke 48 in. The cranks are set 90° apart. Each exhaust chamber is separated by an air space from its cylinder barrel. In the event of the high-pressure crank being on dead center at the starting up of the engine, a small steam pipe leading from the throttle valve will let steam from the boilers into the low-pressure space of the receiver. This connection may be used to supply steam to the low-pressure cylinder when operating non-condensing to increase the horse-power. A safety valve is placed in the exhaust pipe from the high-pressure cylinder to the receiver. If for any reason the low-pressure valves should fail to take steam, the inertia of the engine would run up the pressure in the receiver by forcing the exhaust of the high-pressure cylinder into it, which would cause serious damage, were it not for this safety valve.

The engine governor is located on the low-pressure side of the engine, and is of the Allis special weighted type for operating both the high and low-pressure cylinder valve gears. This governor has attached to it the special mechanism for changing the speed of the engine in order to bring the alternators into synchronism and step. This interesting device is described later. In addition to the speed governor there is a safety governor located on the high-pressure side of the engine, which operates the release catch on the butterfly valve in case the engine speed increases to the predetermined limit for which the release catch is set. The valve is closed by means of a heavy weight, which when falling over its vertical guiding rod in the gallery floor, closes the valve by means of a connecting rod.

The main journals are made so that the bottom parts are spherical in shape, fitting into spherical sockets in the bed plate, thus making a perfect ball and socket joint. This arrangement for securing a self-aligning shaft is common on electrical apparatus, but it is not on engines. The lower half of the journal shell is hollow, so that circulating water can pass through to cool the bearing.

The fly-wheel is 25 ft. in diameter, made in ten segments, and weighs approximately 150,000 pounds. The cranks are of the counter-balanced type, and were pressed on the shaft with a 400-ton hydraulic press and keyed in place. The crank pins are 12 in. in diameter,

and 10 in. in length, and were forced in place by the same means and riveted over.

The guarantees on this engine are as follows: With 175 pounds steam pressure at the throttle and 26 in. vacuum in the condenser the engine will develop at its rated speed 75 r.p.m., 2,250 indicated hp, with a steam consumption not exceeding 12½ pounds of dry steam per indicated hp-hour. The engine will stand 50 per cent. overload under the control of the governor. The regulation from no load to full load is within 1 per cent.

In order to insure the successful operation in parallel of the generators, the maximum allowable variation in angular velocity from mean angular velocity at any load from no load to 50 per cent. over the economical rating is not more than .125 of one degree.

The indicated horse-power, when running at full speed with a steam pressure of 175 pounds at the throttle and no load on the generator, is guaranteed to be not more than 135. The maximum indicated horse-power obtainable at the latest point of cut off at which the governor will regulate within 3 per cent., the initial steam pressure being 175 pounds, is 3,940.

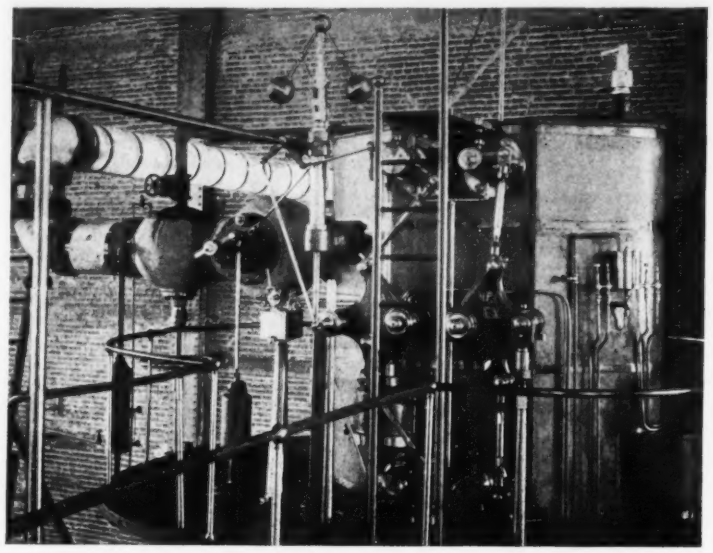


FIG. 5.—VIEW OF HIGH-PRESSURE CYLINDER.

The device for changing the leverage of the governor weight and consequently the speed of the engine can best be described by the accompanying diagram in Fig. 7. *A* is the vertical post at whose top are attached the governor balls. *B* is the cast-iron collar which is held in position on *A* by set screws. It has two legs, as shown, which supports a knife-edged shaft, *T*. A cast-iron platform, *P*, with a yoke, *Y*, is rigidly held on this shaft by set screws. On this platform is mounted a small direct-current motor, *M*, reversible at the switchboard, whose shaft end is a worm, *W*, which turns a

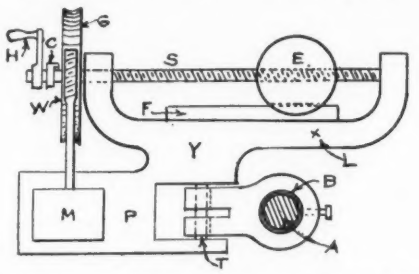


FIG. 7.—APPARATUS FOR CHANGING GOVERNOR LEVERAGE.

gear, *G*, which is free to turn independently. A jaw clutch, *C*, sliding on a feather, engages this gear with the screw, *S*, which in turning moves the weight, *E*, along the screw, the weight being compelled to slide as a feather, *F*, on the yoke, prevents it from turning with the screw. The yoke, as shown, supports a screw at each end, the turning gear end being provided with a double thrust bearing. At *L* is attached one end of a link, whose other end is attached to the sliding part of the governor. From the description of the parts it will be seen that the shaft, *T*, is the moment axis for the governor pull at *L*, multiplied by its perpendicular distance from the moment axis and the combined weight of the motor, the platform, the weight and the attachments times the perpendicular distance of their resultant center of gravity from the moment axis. By the moving of the weight, this resultant center of gravity is changed and in consequence the position of the governor balls is changed. A hand crank, *H*, on the end of the screw, *S*, may be used to turn the screw after disengaging the clutch, *C*, from the gear, *G*.

The boiler plant consists of six boilers of the well-known Babcock & Wilcox type, arranged in three batteries. Each boiler has three 36-in. drums, 23 ft. 3 in. long and 252 tubes 4 in. in diameter and 18 ft. long, having a total of 5,143 sq. ft. of heating surface. At

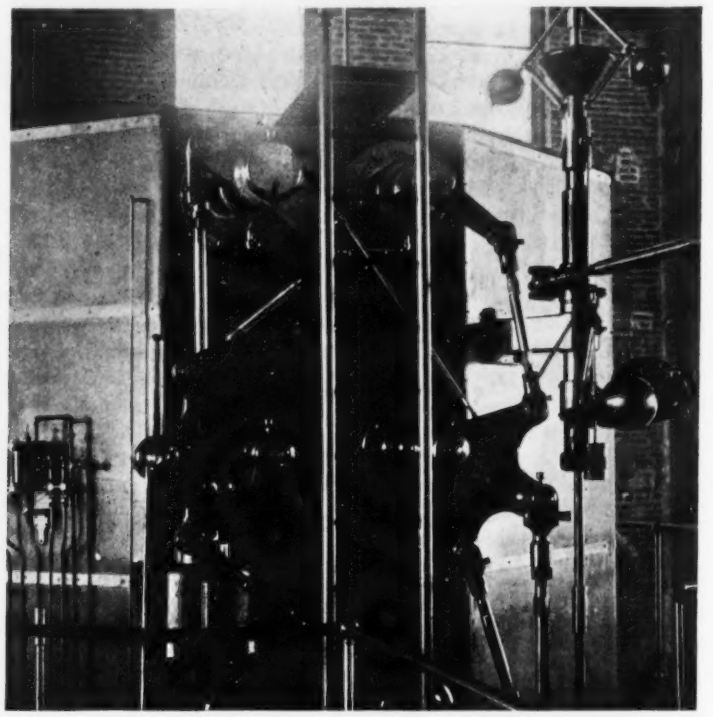


FIG. 6.—VIEW OF LOW-PRESSURE CYLINDER SHOWING SPEED-REGULATING DEVICE.

10 sq. ft. of heating surface per horse-power, each boiler has a normal rating of 514.3 horse-power. The boilers are operated with a steam pressure of 175 pounds, but are built for a working pressure of 200 pounds, and were tested with 300 pounds hydraulic pressure and found to be free from leaks.

Each boiler is equipped with a Green traveling link grate containing 92 sq. ft. of effective grate surface, being 9 ft. wide and 10 ft. 2 in. long. The heating and grate surface of each boiler are, therefore, in the ratio of about 56 to 1. The grate is fed with coal by means of a hopper at the front of the boiler, under which the grate travels. The amount of coal burned is regulated by the speed at which the grate travels. Power for operating the grate travel is obtained through a rod operated from an eccentric on a line shaft, which is suspended from the basement ceiling, and runs the length of the boiler room floor. The line shaft is driven by a belt from either one of two 6-hp oscillating engines set on the basement floor between the ash pits.

Coal is shoveled from cars on a railroad switch into a storage pit on the outside of the boiler room, the boiler room wall forming one side of the storage pit. The floor of the storage pit slopes toward the boiler room wall at an angle of 45°, thus being sufficient slope to allow the coal to freely slide. From the storage pit coal is conveyed to the boilers by means of a coal and ash-handling apparatus manufactured and installed by the Heyl & Patterson Company.

This apparatus consists of a storage hopper, elevator and motor platform, all suspended from a bridge composed of structural steel members, securely braced and supported by four traction wheels. The track for the traction wheels are 23 ft. 9 in. apart, one running over the boilers and supported on girders resting on the front boiler columns, and the other running along the boiler room wall and supported by brackets on the steel building columns.

There are a number of bulkhead gates with sliding steel gates placed at intervals of a few feet in the boiler room basement wall, which, when opened, will allow the coal to slide from the storage pit into the boot of the elevator. The elevator has a lift of 48 ft.

and discharges coal into the storage hopper. The storage hopper discharges coal through a short chute into the hoppers of the Green grates. The elevator can deliver 60 tons of slack coal per hour to the storage hopper, which has a capacity of 10 tons. The bottom of the storage hopper is equipped with a cast-iron gate frame, supporting three sliding steel gates, by means of which the feed of the coal to the grate hoppers is regulated. The hopper is also provided with a scales for weighing the coal.

The various parts of the apparatus are operated from the motor platform, where one attendant can look after the whole operation from opening any of the steel gates and drawing coal from the storage pit to depositing coal into any grate hopper.

The power for operating the apparatus is provided by a 10-hp, 500-volt, direct-current motor, which transmits power by means of a belt to a main countershaft. From this main countershaft, the power for operating the elevator is transmitted by spur gear and roller chain drive to the head shaft of the elevator. The traversing mechanism is also taken from the countershaft and transmitted to the axles of the traction wheels by means of bevel gears provided with friction clutches.

As yet no special apparatus for handling the ashes has been installed, the coal-handling apparatus being used during periods of light load. The ashes are raked from the ash pits on to the basement floor and shoveled into the elevator boot, hoisted into the storage bin, from which they are dropped into barrows and wheeled out.

It was the original intention to install an independent apparatus for handling the ashes. This was to consist of a trolley bucket which would traverse the boiler room basement in front of the ash pit doors, collecting ashes from the ash pits and depositing them into a skip bucket, by means of which they were to be elevated and

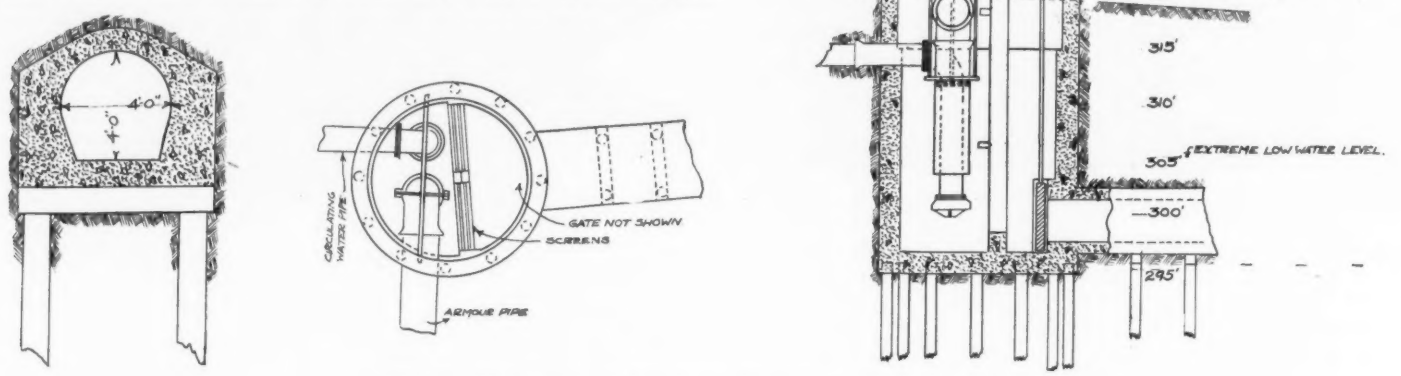


FIG. 8.—DIAGRAMS OF CONCRETE TUNNEL AND SUCTION WELL.

passed into a storage bin at the end of the boiler house, from which they were to be drawn into cars.

AUXILIARY STEAM CONDENSER APPARATUS.

One Wheeler surface condenser takes care of the exhaust steam from both engines. It contains 8,000 sq. ft. of brass cooling surface, measured between the heads, and is capable of handling 80,000 pounds of exhaust steam per hour, this being the amount of the exhaust steam when both of the engines are working at 20 per cent. overload or thereabouts. Handling this amount of steam, it is guaranteed to maintain a vacuum of 26 in. with 5,100 gallons of circulating water per minute at a temperature of 70° F.; and a vacuum of 24 in. when the temperature of the circulating water is 85° F.

The feed water heater is a Webster "Star" vacuum feed water heater and purifier. It has a capacity for heating 80,000 pounds of water per hour from a temperature of 110° F. to temperature of 180° F. to 190° F. when supplied continuously with 6,000 pounds of exhaust steam per hour, and will condense this amount of steam under the stated conditions. The heater will be supplied with exhaust steam ordinarily from the feed water pumps, hot well pumps, stoker engines, air pumps and occasionally by the engine of the steam-driven exciter.

Water for condensing purposes flows from the Kaw River through a concrete tunnel into a concrete suction well, 15 ft. in diameter and 36 ft. 6 in. deep. The water is drawn from the suction well by means of the centrifugal pumps already described, is pumped through the condenser and discharged into an overflow well outside the building, which has a sewer connection to the river. (Considerable difficulty has been encountered in the building of the concrete tunnel owing to the quicksand, and the work is not completed at the time of this writing, the engines being operated on the free exhaust.)

Fig. 8 shows a plan and section of the concrete tunnel and the suction well. The extreme high and low water levels of the river are indicated, showing their elevations with reference to the engine room basement floor, where all the condensing apparatus is located. The center of the suction well is 72 ft. 10 in. from the west wall of the building, and the tunnel extends out into the river a distance of 180 ft. 6 in. from the suction well.

The tunnel is supported every 5 ft. on timber caps, which rest on two piles one under each side wall of the tunnel. The portion of the tunnel extending out into the river has a rip-rap bed in addition to the piling foundation, and it is protected from the debris of the river on the upstream side by means of rip-rap and sheet piling. Water enters the tunnel through an opening in the top, thus avoiding the mud of the bed of the river as much as possible. There is a platform extending from the suction well out over the river, from which logs or drift can be removed from around the end of the intake.

The suction well rests on 12 piles driven under the circular wall. It is divided into two compartments by a double set of screens, the tunnel opening being on one side of the screens and the suction pipes on the other. The double set of screens provides for one set to be raised and cleaned while the other set is down. There is also a gate at the tunnel opening which wedges tight against the water pressure on the tunnel side, and when closed provides for cleaning out the suction well. The suction well is connected to the circulating pumps by a 24-in. cast-iron bell and spigot pipe, which is provided with a foot valve on its bottom. The Armour Packing Company is also a joint user of the intake tunnel and suction well, being supplied through the 36-in. pipe shown in the figure.

By reference to the switchboard wiring in Fig. 10 it will be seen that each generator is connected to two oil-break switches controlled by non-automatic controlling switches on its panel. One oil switch makes connection between the generator and one of the station bus-bar sets and the other between the generator and the other station bus-bar set. These two sets of station bus-bars will be used for separate purposes, one set which is termed the Metropolitan bus-bars will be used for feeding the cables to the Metropolitan Street Railway Company's sub-stations, and the other set termed the Edison bus-bars will be used for feeding the cables to the lighting company's lighting and power sub-stations and for furnishing power normally to the apparatus hereafter described, in the station. However, the auxiliary apparatus may be connected to either or both sets of bus-bars through two sets of knife switches on the leads to the oil-break switches for each auxiliary machine. These knife switches also provide for breaking the connections between the oil-break switches and high-tension bus-bars in case of repairs to the oil-break switches.

Current for exciting the fields of the main generators and synchronous motors, described later, as well as for lighting the station, operating the oil-break switch motors and the auto-controlling

switches, and for operating the engine governor controlling motors is furnished either from a 150-kw, 125-volt, direct-current generator, direct-connected to a 215-hp, three-phase, 25-cycle, 440-volt induction motor or from two Edison 60-kw, 125-volt bipolar generators belted one to each fly-wheel of an Armington & Sims high-speed engine.

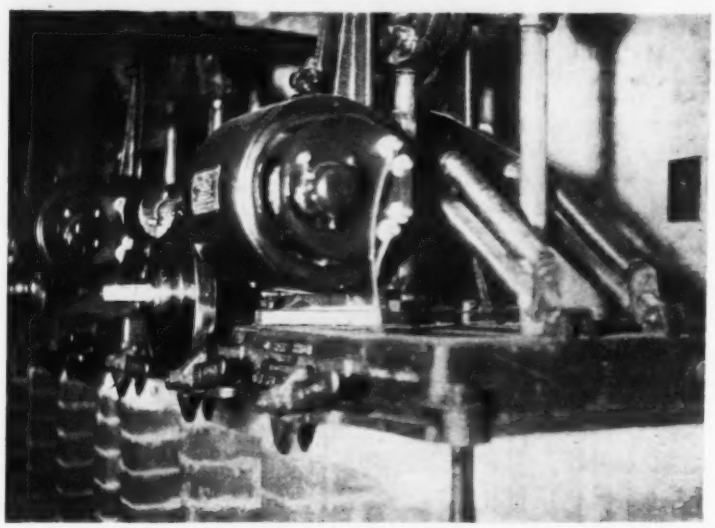


FIG. 9.—VIEW OF OIL SWITCHES.

It is almost needless to say that the steam-driven exciters will only be used for starting purposes, after a complete shut down or in case the motor-driven set should be disabled. The company had the Edison machines and the engine, so no expense except that of their installation was undergone to have steam-driven exciters. An interesting point about the control of these machines is that they are coupled electrically, rheostats are both operated simultaneously by the same hand wheel and a singly equipped panel answers for both. On the motor-driven set the induction motor is put in operation as follows, the connections being traced on the switchboard wiring plan: An auto-controlling switch is closed which causes the motor on the type H oil-break switch to close the circuit from the high-tension bus-bars to the high-tension side of three 75-kw, 6,600 to 460-volt oil-cooled transformers. Between these transformers and the motor is a starting compensator, operated by a crank on the motor panel. The circuit is protected from short circuits by a time limit relay, which closes an auxiliary circuit, which opens the auto-controlling switch. This causes in turn the opening of the H oil-break switch.

There are two 125-kw, three-phase, 25-cycle, 6,600-volt, synchronous motors, direct-connected one to each pair of circulating pumps. There are two sets of auxiliary bus-bars for the operation of these motors, starting and running bus-bars. Between these sets is placed the starting compensator, which is operated by a crank on one of the motor panels. There are two sets of oil-break switches for each motor, one set between the motor and starting bus-bars and the other between the motor and running bus-bars. These switches are operated by levers on the motor panels. An oil-break switch connects the station bus-bars to the motor running bus-bars. In starting a motor, the latter switch is closed, then the set of oil-break switches between the starting bus-bars and the motor, and then the compensator is thrown in, which closes the circuit to the motor. When the compensator switch is on the running position, the set of oil-break switches between the motor and the running bus-bars is closed. The compensator and starting switches will then be thrown off. The compensator may then be used to start up the other motor, if necessary, in an exactly similar manner. A time limit relay is placed on the circuit between the high-tension bus-bars and the oil-break switch. This relay opens the auto-controlling switch, which in turn causes the opening of the switch.

It may be stated here that the controlling switches for the oil-break switches have each a red and a green indicating lamp, one for indicating a closed and the other an open circuit, so that the attendant may see at a glance whether anything is wrong on those circuits closed by oil-break switches.

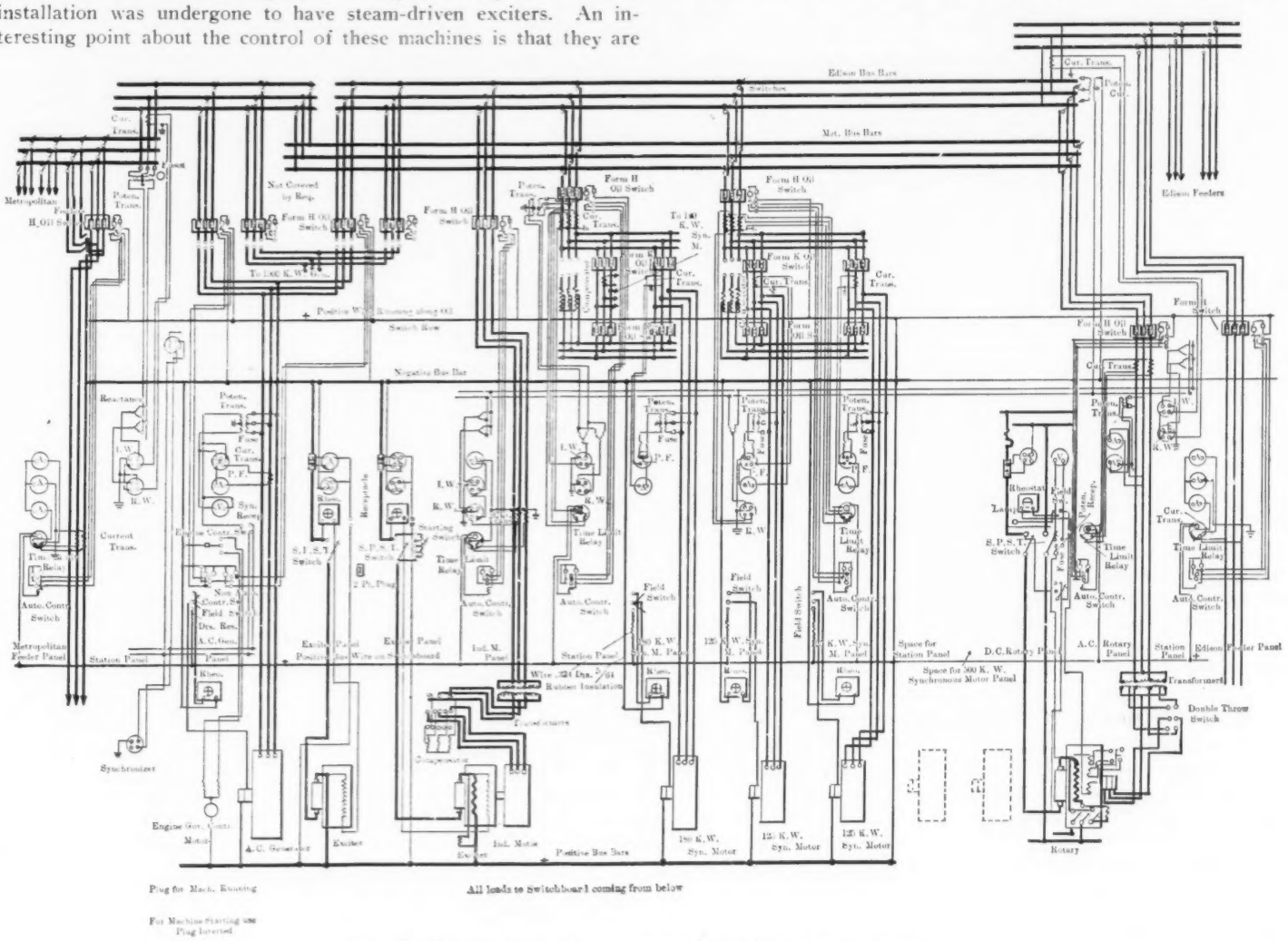


FIG. 10.—DIAGRAM OF WIRING FOR 6,600-VOLT SWITCHBOARD.

There are in the main station four 4-circuit Brush arc dynamos, direct-connected in pairs to 180-kw, three-phase, 25-cycle, 6,600-volt

synchronous motors. The dynamos will furnish power for the street lighting of Kansas City, Kan., on the present system. The switchboard connections of the motors are exactly similar to those of the 125-kw motors described above, using but one compensator and having but an oil-break switch, auto-controlling switch and time limit relay. There may be objection to having but one oil-break switch which in being opened by the protecting devices throws off both motors, though the short-circuit or overload may have occurred on but one of the motor sets. There is this much to say, however: Besides the expense of installing separate switches, which is considerable, the Brush arc dynamos will take care of any short circuit that may happen to occur in any of the lines. At any rate, for the arc service a momentary shut-down of one of the machines on account of the results of a short on the circuits of the other is not a serious matter, as the unaffected machine can be quickly started again.

A 500-kw, 600-volt, 25-cycle, three-phase rotary converter will be placed in the station to furnish power to some of the near-by factories and also to the crane motors, coal-hoist motors and sump pit motor in the station. The 500-volt building motors are operated at present from a railway circuit run into the building.

The rotary will receive power from the main generators through three 175-kw, 6,600 to 340-volt, air-blast transformers. It will be started ordinarily from the alternating-current side. The secondaries of the transformers are to be delta-connected, one lead going direct to the rotary, and the other two going to one side of a double-pole, double-throw switch connecting to the rotary. The other side of the switch will be connected to leads connecting to the secondaries of two of the transformers at their middle points. Thus it will be seen that one-half of the secondary voltage of the transformers can be thrown on the rotary for starting, and the full secondary voltage for running.

Provision will also be made for starting the rotary from the direct-current side on railway circuit by means of a starting switch. A Lincoln synchronizer will indicate when its alternating voltage is in phase with the station three-phase voltage. When this condition exists, an oil-break switch will be closed by means of an auto-controlling switch. The alternating-current side of the rotary will be protected by a time limit relay, and the direct-current side by an ordinary railway feeder circuit-breaker.

There are also placed in the main station two 500-kw, two-phase, 60-cycle, 2,300-volt generators, direct-connected to 500-kw, three-phase, 25-cycle synchronous motors. These generators are used for incandescent service. The motors are connected to the switchboard in the same manner as the 180-kw and 125-kw motors described before, i. e., using one compensator and having but one oil-break switch, auto-controlling switch and time limit relay. The 2,300-volt board has one set of two-phase bus-bars. In the event of a protracted short circuit on a feeder both generators will be protected, as both their driving motors will be cut off from the source of power. Consequently but one oil-break switch is necessary.

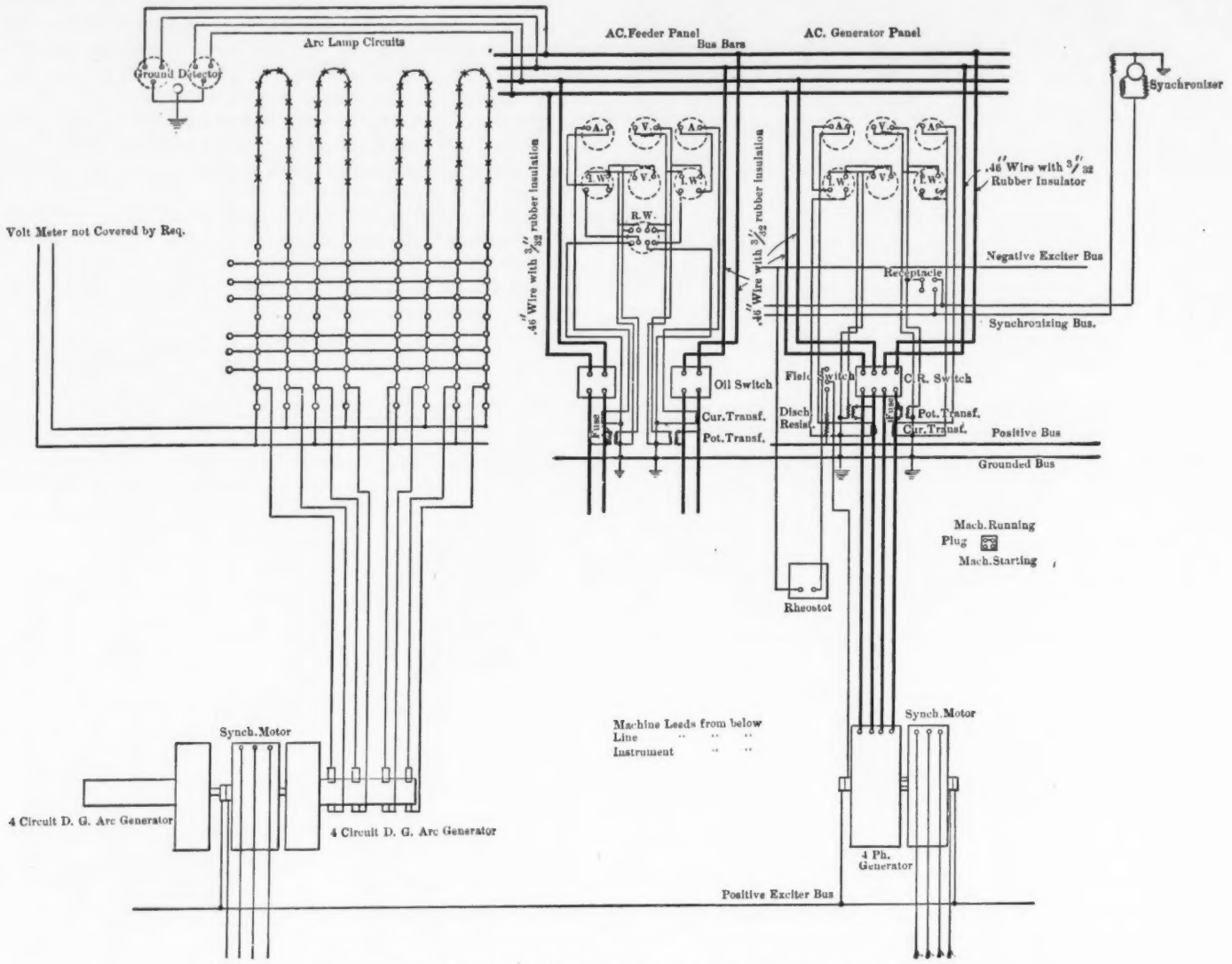


FIG. 11.—SWITCHBOARD WIRING FOR 2,300-VOLT AND ARC LIGHT BOARD.

As stated, the Metropolitan Street Railway Company is to be furnished with power for operating its rotary converter sub-stations. This power is sent out through lead-covered cables from the Metropolitan bus-bars. The lighting company's sub-stations will be fed through lead-covered cables from the Edison bus-bars. The latter sub-stations will have either motor generators to change the frequency to 60 cycles for incandescent lighting, and rotary converters for three-wire, 220 and 110-volt service or both.

All the transformers, bus-bars and oil switches in the main station are placed in the engine room basement under that part of engine room floor upon which the switchboard and auxiliary apparatus are placed. Each oil switch has dividing barriers of brick between the sets of terminals. The bus-bars are mounted on slate floors in brick compartments. All connections to transformers and to feeder circuits are made from "pot heads," i. e., brass bell-shaped ends

on lead cables with insulated covers over the mouths in which are separate openings through which the wires pass.

Each generator panel is equipped with one ammeter registering the current in one of three leads, one voltmeter and one power factor indicator. The two non-automatic controlling switches for the type H oil-break break switches connecting the generator to either set of bus-bars, the engine governor controlling motor double throw switch, and the synchronizing plug are also placed on each panel. The field rheostat wheel is not on the panel, but is placed on a pedestal about 18 in. in front of the panel.

The exciter induction motor panel is equipped with an ammeter, indicating wattmeter and recording wattmeter. The time limit relay and auto-controlling switch and the crank for throwing compensator switch are on this panel.

The two exciter panels are equipped alike except that there is a starting switch on the motor-driven exciter panel for starting up from the direct-current end to overcome the inertia of starting, in case the starting compensator should be injured and cut out. A voltmeter, an ammeter field rheostat wheel, circuit-closing switch and potential plug constitutes the similar apparatus on each exciter panel.

The two 180-kw synchronous motor panels are similarly equipped. There is also a station panel for these motors. Each motor panel has an ammeter and power factor indicator, a field switch, field rheostat hand wheel and two levers for operating the two sets of oil-break switches. The station panel has an indicating wattmeter and a recording wattmeter, time limit relay, and two auto-controlling switches, only one of the latter being used at present, as there is but one oil-break switch in use.

The panels for the two 500-kw synchronous motors not yet shown in switchboard diagram will be of the same type and number as those for the 180-kw synchronous motors described above.

One of the two 125-kw synchronous motor panels has an ammeter, one recording wattmeter for both machines and a power factor indicator. The other panel has an ammeter, a power factor indicator and a time limit relay for the one oil-break switch of the pair. This panel also has the hand crank for operating the compensator. Both panels have field switches and field rheostat hand wheels, and two levers each for operating the two sets of type K oil switches for connecting each motor to the starting and running bus-bars respectively.

The rotary alternating-current panel will have an ammeter, voltmeter, besides a time limit relay, an auto-controlling switch and synchronizing plug and lamps. Synchronizing will be done by means of a Lincoln synchronizer. The rotary direct-current panel will have an ammeter and a voltmeter, the line switches, starting switches, field switch, potential plug, rheostat hand wheel and circuit-breaker.

The feeder panels are seven in number; four will be used by the Metropolitan Street Railway Company, placed at one end of the switchboard, and three to be used by the lighting company, placed at the other end. Each group of feeder panels has a station panel. The apparatus on each panel consists of the following except that the Metropolitan feeders will be in pairs on two oil-break switches; three ammeters, time limit relay and an auto-controlling switch controlling an oil-break switch. Each of the station panels are equipped with an indicating and a recording wattmeter. A Lincoln synchronizer is mounted on brackets on the Edison feeder end of the switchboard.

It will be noted that wattmeters are placed at points from which power is taken. There is no wattmeter measuring the total power of the plant. On each synchronous motor panel the power factor indicator enables the attendant to adjust his motor fields for the minimum input.

The 2,300-volt switchboard is placed at one end and at right angles to the 6,600-volt switchboard. It is made up of two generator and two feeder panels. Each generator panel has an ammeter, a voltmeter and an indicating wattmeter in each phase. A lever handle throws in a set of two-phase oil switches which connect the generator to the bus-bars. In addition there is a field switch and field rheostat handle and synchronizing plug.

Each feeder panel has a recording wattmeter which measures the power through both phases, besides an ammeter, voltmeter and indicating wattmeter in each phase. There are two levers to throw in the single-phase oil-break switches on each panel. Ground detectors for each phase are hung on brackets on one end of the switchboard past the arc panels.

A Lincoln synchronizer is hung on brackets at the other end. This instrument will be used to get the voltages of the two 2,300-volt generators in exact phase by manipulating the driving synchronous motor fields to secure that result, the relative position of the revolving field being changed by changing the field current. There are two panels which are continuous with the 2,300-volt board. These are equipped according to the usual standard type.

The Central Avenue Station was designed and laid out by Pierce, Richardson & Neiler, engineers, of Chicago, under their immediate supervision and that of their Mr. Richardson, the general manager of the Consolidated Lighting Company. Upon change of management of the company in June last, the work of installing and completing the plant was performed by Ford, Bacon & Davis, engineers of New York, under the direction of Mr. C. N. Black, the engineer in charge of their Kansas City office, and to whom the writers are greatly indebted for the means placed at their disposal for the minute study of the plant.

Electrical Transmission From Boston.

TIDEWATER at Boston marks the location of a 50,000-kw generating station that will presently supply energy to points 25 miles west and about 14 miles north and south of that city. The transmission system instituted for this purpose is an extension of the Boston Edison plants.

Up to this time the Edison Electric Illuminating Company, of Boston, has confined its service within the city limits, where its supply is exclusive with small exceptions. The large extension of the Edison system has been made possible by its purchase of the local electric lighting plants at Woburn, Somerville, Milton, Canton, Dedham, Needham, Newton, Natick and Framingham. The ten generating plants in these places will all be shut down, and the entire supply of enegry will be drawn from the new 50,000-kw. station at tidewater in South Boston.

To serve the area now supplied by the ten generating plants just named, six substations will be established, using five of the buildings now occupied as steam driven stations and building one new substation. The locations of these six substations and the names of the cities and towns supplied from each are as follows:

Location of substation.	Cities and Towns Supplied.
Newton	Newton and Watertown.
Somerville	Somerville and Arlington.
Woburn	Woburn, Stoneham and Winchester.
Dedham	Dedham, Canton, Needham and Westwood.
Natick	Natick, Framingham, Wellesley, Wayland, Ashland and Holliston.
Milton	Milton.

The new substation is to be built at Newton. From this list it will be seen that eighteen cities and towns are to be supplied from the six substations. The most distant portions of this territory are Ashland and Holliston, parts of which are fully 25 miles from the new generating station in South Boston. This station will contain generators that will develop three-phase curret of 60 cycles at 7,000 volts. Until the new station is ready for operation current for transmission to the substations already named will be obtained from the present South Boston plant, which operates three-phase and 60 cycles at 2,300 volts for distribution in Boston. This 2,300-volt current will be stepped up to 7,000 volts by raising transformers at the South Boston station for transmission to the substations pending completion of the new station with its 7,000-volt generators. In the location of substations for the wide area covered by the above eighteen cities and towns the idea has been to keep the number of these substations as small as is consistent with first-class service, and particularly good regulation.

The tranmission voltage of 7,000 was found to be sufficiently high to keep the loss in lines between the generating and substations down to 10 per cent. at times of maximum load with moderate costs of lines, and it was thought that a maximum loss as low as 10 per cent. was only warranted on the score of good regulations. Lines between the generating station at South Boston and the several substations are partly overhead and partly underground. As far as at

present decided three main transmission lines will leave the South Boston station for the substations. One of these lines, 64,000 ft. long, will pass to the Dedham substation, 35,000 ft. of this length being underground and 29,000 ft. overhead on poles. The underground portion consists of two cables, each containing three No. 4-0 conductors of copper. The overhead portion of this line consists of two circuits with three conductors each, two of these conductors being equivalent to 1-0 copper, 3-0 aluminum, and the third 2-0 copper. From the Dedham sub-station the transmission line continues a further distance of 55,000 ft. to the sub-station at Natick, which is 119,000 ft. from the plant at South Boston. Between the Dedham and Natick sub-stations the line will consist of three aluminum conductors 1-0 copper, equivalent, all overhead. The Natick sub-station is more distant than any of the others from the South Boston generating plant, being 22.5 miles by the line. From this sub-station the distribution lines will extend some six or seven miles further to Ashland and Holliston, so that the total length of the transmission to parts of these towns will be nearly 30 miles.

Another line connects the South Boston plant with the Somerville substation, a distance of 39,000 ft. Of this distance 18,000 ft. is covered by underground cables, and 21,000 ft. by overhead line. Two cables are used in this case, each containing three No. 4-0 copper conductors. The overhead line connecting with these cables consists of two circuits, and each circuit of three aluminum conductors of 4-0 copper equivalent. From the Somerville sub-station the transmission line continues a distance of 40,000 ft. to that at Woburn, which latter is 79,000 ft. by he line from the South Boston plant. Between the Somerville and Woburn sub-stations the line will consist of two circuits each with three aluminum conductors of 4-0 copper equivalent.

A third transmission line passes from the South Boston station to the Milton substation, a distance of 30,000 ft., 9,000 ft. of this distance being covered by underground cable and 21,000 ft. by overhead line. The underground portion of this line consists of one cable containing three conductors of No. 4-0 copper. The overhead section of the line contains three No. 1-0 copper conductors.

As may be noted above, all of the underground cable is made up of three No. 4-0 or 211,000 cm. copper conductors in a single casing. This cable is insulated entirely with paper. On each conductor the paper is 6-32 inch thick, and outside of the group of three conductors there is another layer of paper 6-32 inch thick. Outside of this second paper covering there is a casing 1-10 inch thick of lead. Spaces between the three conductors of each cable are filled with jute. All this cable is laid in Camp vitrified clay conduit of 3 inches nominal diameter. At junctions between the cables and overhead lines each cable is carried some feet up a pole, and where its conductors connect with the line wires tops are made for groups of lightning arresters. Each of these groups consists of three 2,500 volt arresters, giving a capacity of 7,500 volts, and the arresters are mounted in weather-proof housings on the poles. The large amount of underground work in this transmission is made necessary by the fact that the lines from the South Boston station must pass through the business sections of the city in order to reach the suburbs.

Cement used in laying the conduits was required to be freshly ground, of the best Roslindale grade, and to pass through a No. 50 sieve to the extent of 90 per cent. of its weight. Briquettes of neat cement 1-inch square in cross-section were required to have an ultimate tensile strength of sixty pounds after setting in water 24 hours, and of 100 pounds after setting in water for seven days. Concrete used on the conduits was composed of one part cement, two parts clean, sharp sand, and two parts screened gravel, or crushed stone, to be small enough to pass through a 1½-inch ring.

Before any concrete was laid spruce or pine side boards were placed in the ditch so as to be not less than 3 inches from the sides of the ducts when they should be in position. A concrete bed 4 inches thick was next laid on the bottom of the ditch, from one side board to the other. This bed of concrete was laid to line and grade, and properly rammed. After the tile ducts had been laid on this concrete bed a further layer of concrete at least 3 inches thick was placed at the sides and over the top of the ducts and well rammed. All ducts when laid were required to break joints and to be true to lines and grades. Every joint between ducts was plastered and the spaces between ducts filled with mortor, consisting of one part cement and one part sand.

A layer of kyanized or creosoted 2-inch plank was laid on the top of the conduit when finished. Each duct after it was completed was required to pass a mandrel of 2⅞ inches diameter. The brick walls of manholes were built on a layer of concrete 6 inches thick, and the outsides of these walls were plastered with hydraulic cement mortor consisting of one part cement and two parts sand. Mortor used to lay the brick walls of the manholes was of this same mixture. The bottom of each manhole was plastered and had its lowest point at the center. A layer of concrete 3 inches thick was laid over the iron manhole frame to a depth of 3 inches below the top of the brickwork. In cases where it was thought necessary each manhole was connected with the sewer, using a 6-inch pipe and a 6-inch ¾ "S" trap, with strainer and cesspool of cast iron, complete for the purpose.

Poles used for the transmission lines were of live chestnut shaved, sawed square at both ends, and of the following dimensions:

Length feet.	Circumference at top, inches	Circumference 5 ft. from butt not less than inches.
35	25	42
40	25	44
45	25	50
50	25	57
55	25	63
60	25	69
65	25	75
70	25	82

On straight lines in earth or gravel, poles of the several lengths were set at the following depths:

Length, feet.	Depth, feet.	Length, feet.	Depth, feet.
35	5	55	7
40	5.5	60	7.5
45	6	65	8
50	6.5		

On curves all poles were set 6 inches deeper than here stated, and were given a certain amount of lean. Each hole for a pole was required to be 8 inches larger in diameter at the bottom than the butt of the pole to be placed therein. In filling about each pole one shovel and four iron tamps were required to be constantly in use, and large stones or bricks were not permitted to be used. Where the soil was too soft to tamp an artificial foundation for each pole was provided, and if the pole was located on a curve it was braced. Poles were so selected as to their lengths and locations that there might be no abrupt changes in the level of line wires. After its erection each pole was painted with two coats of raw linseed oil and white lead paint. Where necessary each pole was guyed with a cable consisting of seven No. 9 galvanized steel wires, and a strain insulator was placed in each guy cable at a distance of 6 ft. from its pole.

Galvanized iron steps were located on alternate sides of each pole in holes bored for the purpose at right angles to the cross-arms. These steps were spaced 18 inches on centres for poles of less than 63 inches circumference, and 12 inches on centers for poles of more than 63 inches circumference. Gains in the poles were painted with a coat of lead and raw linseed oil, and the cross-arms were placed in the gains before this point was dry.

All cross-arms were made of seasoned Norway pine, or long-leaf yellow pine, and were painted with two coats of white lead and raw linseed oil. Each cross-arm was fastened to the pole by two galvanized iron lag screens, each ⅝ inch by 8 inches, and fitted with washers. Two galvanized iron braces, each ¼ inch by 1½ inch in section, were used with each arm and fastened to it, and the pole by galvanized iron lag screens each ½ inch by 4 inches. Holes were bored for lag screws, and they were turned in, not driven in. All cross-arms were of standard six-pin size, with centres of pin holes 15 inches apart on each end of an arm. These cross-arms were located 30 inches apart on each pole, three arms per pole.

Locust pins, with steel cores, were used in all cross-arms. Each of these pins was 9½ inches long over all and 5½ inches long above the shoulder. The top end of each pin was cut with ten threads for a length of 2½ inches. At the top of each pin outside of the threads the diameter was ⅞ inch, and the depth of threads was about 3-32 inch. At the shoulder, just above the cross-arm, the pin diameter measured 1⅝ inches, just below the shoulder 1 7-16 inches, and at the lower end 1 5-16 inches. Each pin contained a steel core ⅜ inch in diameter, and extending from near the top to a point 2 inches below the shoulder. Pin holes were bored entirely through the cross-arms, and each pin was dipped in the lead paint before mentioned, and then driven into position. A ⅜-inch hole was bored through the cross arm and the center of each pin, and a ⅜-inch dowel of hardwood was driven entirely through the arm in this hole.

Glass insulators were mounted on these pins, each insulator having a double petticoat, a total height from top to lower edge of 5 inches and a diameter at its lower edge of 5½ inches. Line wires were tied to the sides of insulators. The copper and aluminum line wires were hung with sags that ranged from 12 to 24 inches on the regular spans of 125 ft. each. Line wires were tied to insulators by passing the tie wire around the insulators and then twisting each end of the tie four times around the line wire. All joints in solid line wires were made Western Union style, with four turns on each end and joints in copper lines were then soldered. Each joint was covered with two layers of rubber tape, and outside of this two layers of black friction tape. This joint was then painted with asphaltum paint.

The sizes of tie wires used with the several sizes of line wires were as follows:

Line wire No.	Tie wire No.
4	4
2	4
1-0	1
2-0	1
3-0	1-0

The ends of all tie wires were cut close to their line wires after being twisted about the latter.

All drops from line wires on a higher to those on lower arms were carried outside the ends of the higher arms by means of header cross-arms placed on the regular arms.

Lightning arresters are connected to each conductor cable outlets only at sub-stations. Each lightning arrester is grounded by a No. 1-0 copper wire run down the pole and twisted into a flat coil at the lower end. This coil is buried near the base of the pole at least 6 ft. under the surface of the ground. The No. 1-0 wire is insulated to a point 1 ft. below the surface of the ground, and below the insulation the wire and its coil are surrounded with broken coke.

The 7,000-volt overhead lines were so strung that all wires are 30 inches apart. Each pole carries three cross-arms and one wire of each three-phase circuit is strung on each of these arms. This arrangement of wires has been adopted to render it difficult to lodge a falling wire on other conductor on the two-line wires of the same circuit.

Distribution in the cities and towns supplied by this transmission system will be carried out with alternating current exclusively for lighting and stationary motors. Commercial lighting and stationary motors will be operated from three-phase circuits at 2,300 volts. Arc and incandescent street lamps will be operated with constant-current transformers in some cases, and with constant-current regulators in others. At Natick and at Woburn the present generating stations are delivering some 500-volt direct current for electric railways. When the transmission from South Boston is in operation these demands for railway current will be met by motor generators in the substations. The three-phase synchronous motors will draw current directly from the transmission line at 7,000 volts, thus avoiding the use of transformers. Arc dynamos will be done away with at all of the substations. Some of these stations already have constant-current transformers and regulators for arc and incandescent street lighting, but in other stations this class of equipment must be added. At each substation the 7,000-volt three-phase current from the transmission line will be transformed to 2,300 volts. Service transformers will reduce this pressure to 115 volts for lamps, so as to conform with the Boston practice, and make one voltage of lamps available for all renewals. Equipments for all of the sub-stations have not yet been decided on, but the following may be mentioned for some of them:

At Dedham three transformers of 250 kw. each, one 50-lamp constant-current transformer, and seven 7½-kw. regulators will be installed.

At Natick the new equipment will include three transformers of 200 kw. and three of 100 kw. each, four constant-current transformers for 50 lamps each, and six 7½-kw. and one 10-kw. regulators.

In the Somerville substation two transformers of 300 kw. each will be added.

All regulation of the distribution lines will be done at the substations; but in one or more instances, the 7,000-volt lines will be made a part of the distribution system, and will extend beyond a substation to a bank of stepdown transformers in another town. Thus the 7,000-volt lines will extend from the Natick substation to South Framingham, where a bank of transformers will reduce the voltage to 2,300 for the local service, but regulation of pressure for this service will be done at the Natick substation. In order to make regulation of this sort effective two 7,000-volt circuits will be strung between Natick and South Framingham, and one of these circuits will be devoted to street lighting while the other supplies commercial service.

Where two or more of the 7,000-volt circuits supply the bus-bars at a sub-station, each of these circuits is provided with automatic reverse current circuit breakers, so that a short circuit or ground connection on one of these circuits will not draw energy from the others through the substation switchboard. Time limit circuit-breakers will be provided at the several substations, and these breakers will be so set that short circuits on the more remote parts of the system will not interrupt the service on the parts nearer to the South Boston station. This result is reached by setting circuit breakers on more distant parts of the system so that they will open more quickly in case of a short circuit than the circuit breakers nearer the generating plant. The above described transmission system does not provide for electrical supply in Newton and Chelsea because the equipment that will be used to serve these cities has not been decided on.

The ten electric plants above named represent a large addition to the Boston Edison system in service area, connected load and earning capacity. Just how great the ultimate additions on this account may prove to be cannot now be stated, partly because many towns which now have no electric service lie close to the transmission lines, and may be expected to draw supplies from it at a future time. On June 30, 1902, the connected loads of the several electric plants were as follows:

Location of plant.	No. of arc lamps.	No. of incandescent lamps.	H.P. of motors.
Woburn	261	22,214	213½
Chelsea	330	17,062	447
Somerville	600	21,601	278
Milton	...	10,924	...
Canton	46	3,092	...
Dedham	36	7,212	...
Needham	...	3,047	1½
Newton	240	27,193	23½
Natick	23	7,869	20
Framingham	39	6,912	...

The foregoing figures do not include the connected loads of the municipal electric distributing plant in Wellesley for which energy has been purchased from the Natick plant. At Wellesley the municipal load was 597 incandescent lamps on the same date.

Combining these municipal loads with those before named it appears that the combined load on these ten plants amounted to 1,575 arc lamps, 124,676 incandescent lamps, and 1,396 horse-power in motors on June 30, 1902. Since that date this connected load has no doubt materially increased. For the year ending at the date just named the gross and net earnings of these ten stations from sales of electrical energy were as follows:

Location of plant.	Gross earnings.	Net earnings.
Woburn	$84,544.73	$37,731.38
Chelsea	70,841.00	11,918.77
Somerville	123,900.59	55,664.40
Milton	29,541.73	15,313.26
Canton	9,953.59	2,580.48
Dedham	24,028.29	8,906.31
Needham	7,932.68	772.26
Newton	79,458.86	12,549.62
Natick	37,553.32	6,289.86
Framingham	24,114.25	5,732.88

It may be expected that the economies resulting from the operation of the above loads by a single generating station will materially increase the ratios of net to gross earnings shown by above plants.

Steel Making by Electricity.

It is stated that Canadian capitalists have secured the Ruthenborg process of making steel by electricity, and in the near future will construct a mammoth electrolytic steel plant on the Welland River at Chippewa, using a large block of Canadian Niagara power. Dr. Haanel, Superintendent of Mines, recently returned to Ottawa from Lockport, N. Y., where he inspected the new process for the electrical treatment of magnetic iron ores. There are enormous beds of magnetic iron ore in Ontario and Quebec, which can be profitably utilized. There is, however, no fuel convenient to these deposits, but there are water powers from which almost unlimited electrical energy can be cheaply produced.

Rise of Efficiency in Electric Stations.

By Alton D. Adams.

EFFICIENCY of electric stations has made a marked advance during the past decade. To prove this proposition for stations in Massachusetts two classes of data are available, namely, the prices and incomes from sales of electrical energy on one hand and the capacities of lamps and motors supplied, with the weights and costs of fuel consumed on the other. Before 1896 figures for the cost of fuel in all the stations of the State are not available, but the costs of station operation in prior years give an indication of the relative costs of fuel. The truth of this last statement may be gathered from the fact that in the fiscal year of 1896 the cost of fuel for all stations under private ownership was 44 per cent. of their total cost of operation. For the year of 1890 the cost of operation at all of these stations was 39 per cent. of their income from sales of electrical energy, but for 1895 the corresponding per cent. declined to 35.

Energy incomes and costs of operation for all stations:

Year ending June 30.	Energy incomes	Costs of station operation.	Per cent operation costs to incomes.
1890	$1,908,394.00	$752,831.18	39
1891	2,432,869.15	1,014,242.88	41
1892	2,947,199.64	1,156,320.69	39
1893	3,427,576.84	1,376,946.15	40
1894	3,623,056.92	1,389,187.27	38
1895	3,794,060.41	1,358,689.83	35

From these figures it is hard to avoid the conclusion that the proportionate outlay for fuel declined rather than rose during the period. Beginning with 1896, the cost of fuel is separate from other items, and in that year this cost was 15.54 per cent. of the total energy income of all the private stations. The next three years each show a reduction of this per cent., and there was a slight rise to 14.18 in 1900. This corresponds to a reduction of 9 per cent. in the ratio of fuel cost to energy income during the period.

Energy incomes and costs of fuel:

Year ending June 30.	Total energy income.	Cost of fuel.	Per cent fuel cost to energy income.
1896	$4,148,681.71	$644,996.91	15.54
1897	4,467,146.60	693,479.59	15.52
1898	4,775,316.07	673,026.98	14.09
1899	5,046,412.75	702,925.20	13.92
1900	5,622,556.43	797,743.73	14.18

The two sets of figures just presented show a small decrease in the ratio of fuel cost to energy income during the decade under consideration. Assuming the cost of fuel per unit of heating capacity to have been constant during this period, the efficiency of electric stations must have risen slightly if prices were the same throughout. If average prices rose greatly, the general efficiency must have declined. If prices fell, the average efficiency advanced. At one of the largest inland stations of the State the average prices paid for coal in each year were: In 1892, $3.43; 1893, $4.14; 1894, $4.43; 1895, $4.07; 1896, $3.97; 1897, $4.29; 1898, $3.67; 1899, $3.75; 1900, $4.39 per ton. At a large station on tide water the prices were: 1895, $3.17; 1896, $3.35; 1897, $2.77; 1898, $3.13; 1899, $3.00.

Evidently these prices for soft coal, the principal fuel, did not cause the decline in ratio of fuel cost to energy income. Commercial prices per unit of energy sold by electric stations during the past decade cannot be accurately determined from the data at hand. It is possible, however, to show very clearly what the general movement of these prices has been during the period. One of the means by which a conclusion as to relative prices can be reached is found in a comparison of the total income from sales of electrical energy in each year with the dynamo capacities of electric stations in the same year. The table shows that for each kilowatt of dynamo capacity in electric stations of Massachusetts for the fiscal year of 1890, an income of $125.12 was received from sales of electrical energy during the year. For 1892 this income rose to $139.09, but since that year there has been a constant and rapid decline in its amount. This decline is not due to any falling off of the amount of energy sold, for the energy income of 1892 was only 52 per cent. of that of 1900. During the fiscal year of 1900 the energy income of electric stations per kilowatt of dynamo capacity was $81.51, or only 59 per cent. of the like income for 1892. Unless the conditions of electrical supply were much more adverse in 1900 than in 1892, this change of income seems to indicate a large reduction of prices. It may be suggested that the ratio of dynamo capacities to maximum loads has increased with the general improvement of electric stations, but it is at least equally true that average loads have gone up faster than maximum loads, due to the rise of electric motive power and the extension of day lighting in business houses. It can hardly be maintained that dynamo capacities have increased sufficiently, relative to the average load, to reduce the income per unit of capacity by 41 per cent. The only other conclusion is that of a reduction in price. The income figures thus far given are for both commercial and public lighting, but it can be shown that price reductions have taken place as to each sort of service. Beginning with the fiscal year of 1896, it is possible to divide the total energy income into the parts received for service to commercial arc lamps, commercial incandescent lamps, public arc lamps, public incandescent lamps and for electric power.

Energy incomes of electric stations per kilowatt of their total dynamo capacity:

Year ending June 30.	Kilowatts dynamo capacity.	Total energy income.	Total per kilowatt capacity.
1890	15,244	$1,908,394.00	$125.12
1891	18,593	2,432,869.15	130.84
1892	21,188	2,947,199.64	139.09
1893	26,953	3,427,576.84	127.16
1894	31,749	3,693,056.92	116.32
1895	33,256	3,794,060.41	114.08
1896	40,226	4,148,681.71	103.13
1897	45,461	4,467,146.60	98.26
1898	50,490	4,775,316.07	94.57
1899	63,020	5,046,412.75	80.07
1900	68,941	5,622,556.43	81.55

For the fiscal year of 1896, 11,100 public arc lamps were operated by electric stations at a total price of $1,170,627.73, or an average of $105.46 per lamp. The like average was less in each year thereafter, and in 1900 amounted to only $99.17 per lamp. This represents a reduction in price of 6 per cent.

Incomes and prices of public arc lamps:

Year ending June 30.	Number public arc lamps.	Income from public arc lamps.	Average price per lamp.
1896	11,100	$1,170,627.73	$105.46
1897	11,695	1,179,197.17	100.83
1898	12,104	1,247,708.61	103.08
1899	13,092	1,278,571.07	97.66
1900	13,462	1,335,103.02	99.17

Public incandescent lamps are a comparatively unimportant item, and the total income derived from them is only about one-fourth of the like income from public arc lamps.

Incomes and prices of public incandescent lamps:

Year ending June 30.	Public incandescent lamps.	Income from public incandescent lamps.	Income per lamp.
1896	13,307	$251,393.03	$18.89
1897	14,834	292,492.01	19.71
1898	15,632	319,671.36	20.45
1899	15,980	320,706.55	20.06
1900	17,611	336,593.11	19.11

Between 1896 and 1900 the income of electric stations per public incandescent lamp varied but little, having been $18.89 in the former year and $19.11 in the latter, an increase of 1 per cent.

Turning to commercial service, a much more rapid reduction of prices is notable than that found for public lamps. Commercial arc lamps numbered 7,614 in 1896 and the average income from each was $68.57. In 1900 there were 9,893 of these lamps and the average income per lamp was $53.81. The latter year thus shows a reduction as to the former of 21 per cent. in the average price per lamp in use.

Incomes from commercial arc lamps:

Year ending June 30.	Commercial arc lamps.	Income from commercial arc lamps.	Income per lamp.
1896	7,614	$522,105.08	$68.57
1897	7,834	575,834.23	73.50
1898	7,743	564,593.82	72.91
1899	8,161	529,459.80	64.87
1900	9,893	532,374.29	53.81

In this connection it may be noted that for the year of 1896 each public arc lamp yielded a revenue of 53 per cent. greater than the revenue from each commercial arc lamp, on an average. For 1900 the average revenue from each public arc was 84 per cent. greater than that from each commercial arc. Commercial income per connected incandescent lamp, like that per arc, shows a material decline between 1896 and 1900.

Incomes from commercial incandescent lamps:

Year ending June 30.	Commercial incandescent lamps.	Income from commercial incandescent lamps.	Income per lamp.
1896	535,072	$1,687,255.58	$3.15
1897	648,139	1,828,844.28	2.82
1898	743,266	2,006,414.96	2.69
1899	851,742	2,190,493.10	2.57
1900	973,579	2,580,019.28	2.64

Commercial incandescent lamps to the number of 535,072 yielded an average income of $3.15 each in 1896, and 973,579 of these lamps earned $2.64 each in 1900. These figures show a decline of 16 per cent. in the income per lamp for the period. Each public incandescent lamp yielded an average revenue 500 per cent. greater than each commercial incandescent lamp for the year of 1896, and for 1900 this per cent. rose to 624. Electric motors as well as lamps show a decided reduction of commercial income per unit of capacity during the period under consideration. For 1896 the rated capacity of motors supplied from electric stations was 13,930 hp, and the average income per horse-power from these motors was $37.13.

Incomes from electric motors:

Year ending June 30.	Horse power of all motors.	Income from electric power.	Income per horse power.
1896	13,930	$517,300.29	$37.13
1897	16,318	590,778.91	36.20
1898	18,930	636,927.32	33.64
1899	22,740	727,182.23	31.95
1900	27,133	838,466.73	30.90

In the year of 1900 electric service to motors of 27,133 aggregate horse-power yielded an average income of $30.90 per hp. The income per unit of connected capacity for electric motors was thus 17 per cent less in 1900 than in 1896. Public lighting as a whole during this period yielded a declining income per unit of energy capacity in the lamps supplied, because the fall of 6 per cent. in the average earnings per arc more than offsets the rise of 1 per cent. in the average earnings of each public incandescent lamp. This reduction of income per public lamp, and, in commercial service, a fall of 17 per cent. per horse-power of motors, 16 per cent. per incandescent lamp and 21 per cent. per arc lamp, in average yearly revenue, seem to point to lower prices for energy all along the line. Against such a conclusion it can only be urged that the average hours of service from each lamp and motor per year have decreased during the period. Just the reverse of this is probably true, however, as it is a matter of general observation that the tendency has been for the daily periods of service from street and private lamps and from motors to increase. It follows that prices have fallen at least as rapidly as the income per unit capacity in lamps and motors supplied. While the ratio of fuel cost to energy income has declined more than 9 per cent., the energy income per kilowatt capacity of dynamos in electric stations has grown smaller by 41 per cent., and like income per unit of capacity in connected lamps and motors has shrunk from 6 to 21 per cent. All this argues a substantial increase of efficiency. Results thus far relate to all of the electric lighting stations of the State under private ownership, and show merely the average result. As many stations may have failed to make material advances in efficiency, particularly in small places, it is probable that the best stations have done much better than just indicated. Massachusetts contains 33 cities. In three of these the electrical supply is derived from stations in other cities. Two cities operate public electric plants. Water power is used in connection with electric stations in three cities. Of the 25 remaining cities, 24 have only one electric lighting system each, and one, Boston, has several such systems. Two of the electrical systems at Boston and the single system in each of the other 24 cities are here considered to determine their changes of efficiency during the past decade. The first step in this direction is to find the yearly energy income at each city per ton of coal consumed by its electric lighting system. Coal is stated in long tons of 2,240 pounds each. Small amounts of coke have been used in some plants, and this coke is included with the coal on the basis of 2,000 to the ton. In instances where screenings have formed a part of the fuel, only 85 per cent. of their weight has been added to that of the coal. For each electrical system the income derived exclusively from sales of energy in each year has been divided by the corresponding number of tons of coal. Each electrical system is designated by the name of the city in which it is mainly located. A glance at the table shows great diversity of results; in some systems the income per ton of coal has remained nearly constant; in others it has largely increased, and in still others it has materially declined. Good examples of nearly constant incomes per ton of coal, looking at the entire period rather than at fluctuations in single years, are found in Lowell, Fall River, Lynn, Somerville, Newton, Waltham, Brockton, Northampton and Marlboro, a total of nine cities. In five cities there has been a decided decrease in the energy income per ton, namely in Pittsfield, Chelsea, North Adams, Beverly and Newburyport. Twelve plants, namely, the Brockton Edison, Boston Electric, Cambridge, Worcester, Salem, Woburn, Haverhill, New Bedford, Quincy, Gloucester, Malden and Fitchburg, have yielded a substantial gain in the income per ton. As a rule, the incomes per ton of coal for each system are consistent from year to year, and show only such changes as may readily be due to fluctuations in prices or to improvements of efficiency. There are, however, a few figures for incomes per ton that seem to be due to errors in the original reports as to the tons of coal burned in certain years. Incomes per ton that are probably incorrect are those at Lowell, Worcester and Malden in 1892, at Somerville, Haverhill and Newburyport in 1893, at Newton and Beverly in 1896, at Woburn and New Bedford in 1898, at Newburyport in 1897, and at Beverly and Newburyport in 1900. Reports for the weight of coal from 26 stations during nine years involve 234 separate quantities, and the eleven reports that appear incorrect constitute only 5.5 per cent. of the total. In general it may be fairly said that these figures as to incomes per ton of coal carry on their face evidences of truth, when considered with the known facts of electrical supply. It is of interest in this connection to know that the figures for fuel consumption are sworn to by the officers of electric corporations, as required by law, and a willful misstatement is perjury.

Energy incomes of electric stations in dollars per ton of coal burned:

Stations.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
Boston, Edison	23.89	20.85	25.17	30.63	33.12	32.23	29.57	26.20	28.75
Boston, Electric	21.48	24.47	23.91	23.81	23.24	23.65	22.53	21.15	31.24
Lowell	32.83	22.39	24.07	20.44	24.14	24.50	17.16	21.22	21.90
Cambridge ...	18.22	21.16	21.60	21.82	19.81	19.55	21.77	22.36	24.59
Pittsfield	17.54	17.06	15.95	14.69	13.64	12.32	14.26	13.98	12.75
Fall River	29.61	34.02	33.16	32.02	32.77	28.57	27.27	27.16	29.00
Worcester	39.56	33.08	34.78	32.63	35.86	38.25	40.28	40.38	44.40
Somerville ...	19.34	37.27	23.17	19.57	22.76	21.83	23.07	22.57	22.07
Lynn	34.38	32.15	35.12	37.93	39.27	37.29	37.31	34.78	32.69
Salem	18.75	18.45	18.71	21.02	21.32	24.43	23.71	21.70	22.19
Brockton	22.92	20.87	18.57	16.01	20.28	18.74	18.29	18.43	19.61
Chelsea	25.20	22.17	20.10	18.55	18.23	16.37	15.04	17.09	17.32
Newton	15.27	11.13	13.51	14.67	90.61	13.39	15.46	14.26	16.66
Waltham	13.57	17.56	16.12	14.51	13.83	12.76	14.39	14.28	14.64
North Adams .	25.13	17.66	21.76	20.18	18.51	13.72	14.35	16.05	15.12
Woburn	....	13.37	14.39	12.28	12.82	11.60	8.36	11.43	18.62
Malden	28.77	18.43	26.37	22.82	24.31	22.84	24.88	24.53	25.45
Haverhill	18.26	51.10	28.35	23.77	25.32	24.71	27.57	26.21	30.61
New Bedford .	17.58	17.32	22.39	24.65	25.21	26.18	42.23	24.05	32.31
Fitchburg	26.93	24.99	31.00	25.14	23.68	24.17	25.34	28.46	29.81
Northampton .	19.51	24.04	20.63	19.38	17.92	20.08	20.45	20.71	18.46
Quincy	15.01	14.67	14.51	14.68	17.46	19.58	19.96	19.10	20.46
Gloucester	23.81	17.49	14.72	17.52	15.91	22.17	19.36	22.38	24.25
Beverly	30.88	32.09	34.98	33.26	42.94	15.53	15.57	16.97	36.07
Marlboro	26.12	26.68	23.38	21.37	21.67	21.69	22.32	22.05	24.63
Newburyport ..	30.26	36.71	27.75	23.49	24.54	6.38	21.67	23.44	33.10

Of the 26 electric lighting systems above considered, 9 are owned by gas companies, namely those at New Bedford, Lynn, Newton, Fitchburg, Chelsea, North Adams, Waltham, Beverly and Newburyport. The remaining 17 lighting systems are owned by purely electric corporations. Of these 9 gas companies that operate electric lighting systems, those at Chelsea, North Adams, Beverly and Newburyport, or 44 per cent. of their totals, show a decided decline of energy income per ton of coal during the decade. The gas companies at Lynn, Newton and Waltham, or 33 per cent. of the total, have held their income from electrical energy per ton of coal at a fairly constant figure. Two gas companies, those at New Bedford and Fitchburg, or 22 per cent. of those operating electrical systems, have made decided gains in their energy incomes per ton of coal. Of the 17 purely electric systems, the Boston Edison, Boston Electric, Cambridge, Worcester, Salem, Woburn, Haverhill, Quincy, Gloucester and Malden plants, or 58 per cent. of the total, have earned a rising income per ton of coal during the decade. The plants at Lowell, Fall River, Somerville, Brockton, Northampton and Marlboro, being 35 per cent. of those that are purely electric, have maintained a nearly constant energy income per ton. Only one purely electric plant, that of Pittsfield, representing 6 per cent. of the 17, has suffered a decided loss in energy income per ton. While 58 per cent. of the purely electric companies have gained in energy income per ton, only 22 per cent. of the gas companies have made similar

gains. While 44 per cent. of the gas companies have lost in energy income per ton, only 6 per cent. of the electric companies have made a similar loss. These facts bring to mind the words of a very old book concerning a man who tries to serve two masters.

Omitting the figures above stated to be probably incorrect, the most notable changes in incomes per ton of coal between the years 1892 and 1900 are as follows: Comparing incomes in the latter with those in the former year, it appears that the Boston Electric system made a gain of 45, the Haverhill of 67 and the New Bedford of 83 per cent. per ton of coal. On the other hand, between 1892 and 1900, Pittsfield lost 27, Chelsea 31, North Adams 40 and Beverly, to 1899, 45 per cent. of the energy income per ton for the earlier year. At first glance it may be thought that declining incomes per ton necessarily imply lower efficiencies, but this is not conclusive, for the influence of changes in prices has to be reckoned with. Unless prices have risen to a corresponding degree, increasing incomes per ton of coal certainly indicate higher efficiencies. In order to draw certain conclusions as to efficiencies in these 26 electrical systems, it is necessary to determine the movements of the prices they received for electrical energy during the period. It is alike impossible and unnecessary to find the actual prices paid for each class of service, but relative prices from year to year can be ascertained, and this is sufficient for present purposes. For each electrical system the income from sales of electrical energy and the total connected load are given yearly. If the energy income is derived in each case by the number representing the kilowatts of total connected load, the income per unit of connected load in each year is determined, and relative prices are approximately shown, from year to year. The connected load is made up of three items; arc lamps, incandescent lamps and motors. To obtain from these items the equivalent kilowatts of connected capacity, the number of arc lamps is multiplied by 0.4, the number of incandescent lamps by 0.06, and the horse-power of motors is taken to represent kilowatts, thus implying an efficiency of 74.6 on an average.

Figures thus obtained for these three kinds of loads are added to obtain the total kilowatts of connected capacity for each system yearly. It is not thought that these kilowatt figures are exact, but it seems that they are sufficiently accurate for present purposes, and that any errors they contain will not operate more strongly in one year than in another. The number representing total kilowatts of connected capacity for each station in any year is used to divide the energy income of the station in that year. These calculations have been carried out for the 26 electrical systems in the years 1892 and 1900. No doubt the general reduction of incomes per kilowatt capacity in connected lamps and motors is due in large part to the fact that the average yearly hours of service to parts of the apparatus have decreased.

Incomes of electrical systems per kilowatt capacity of connected lamps and motors:

System.	Income, 1892.	Income, 1900.
Boston Edison	$66.55	$48.54
Boston Electric	248.66	82.67
Lowell	140.39	43.66
Cambridge	204.00	52.52
Pittsfield	99.32	53.27
Fall River	250.10	76.23
Worcester	253.35	99.48
Somerville	162.23	75.66
Lynn	150.05	55.62
Salem	159.15	51.74
Brockton	73.81	54.27
Chelsea	104.62	51.86
Newton	130.46	50.52
Waltham	179.68	59.06
North Adams	201.09	37.87
Woburn	97.73	46.43
Malden	152.56	64.09
Haverhill	190.19	58.53
New Bedford	72.10	48.80
Fitchburg	162.71	71.84
Northampton	108.70	40.80
Quincy	146.40	49.60
Gloucester	171.45	52.13
Beverly	228.41	66.93
Marlboro	133.52	52.72
Newburyport	209.65	120.03

This decrease is largely due to the great additions of residence lighting. It seems quite certain, however, that varying portions of the reductions in incomes per unit of connected capacity are the result of lower prices. Figures for incomes of the Edison systems at Boston, Brockton and New Bedford support this view, as it seems very improbable that these low-pressure plants have taken on enough residence lighting to lower their incomes to the extent indicated. It is also to be noted that these three systems, which have made comparatively small extensions to residences, have lowered their incomes per connected kilowatt capacity less than any of the other plants. Between 1892 and 1900 the income per kilowatt of connected apparatus of the Boston Edison decreased 27, of the Brockton Edison 26, and that of the New Bedford Edison 32 per cent. Meantime the Boston Electric Company, selling in direct competition with the Edison Company, in the territory of the latter, reduced its income per kilowatt of capacity in connected apparatus 67 per cent. How much prices of electrical energy have been reduced in any particular city cannot be determined, because of the variable factor of residence lighting, but that they have been lowered to some extent in every case seems practically certain. With this result in view, it appears that electrical systems which have maintained a nearly constant income per ton of coal, must have increased in efficiency. Even plants where the income per ton has declined may have lost only through lower prices. In the larger number of purely electrical systems the energy income per ton of coal has persistently risen in the face of falling prices. The obvious conclusion is that a very substantial rise in efficiency has taken place during the decade.

Expansion of Electrical Supply in Springfield, Mass.

ELECTRICAL supply in Springfield, Mass., which is mostly transmitted from two water-power stations on the Chicopee River, is expanding rapidly. This fact appears at once from the figures for the output in kilowatt-hours of the system. Taking the number of kilowatt-hours delivered by the Springfield system during the year ending June 30, 1901, as unity, the corresponding number for the year ending at like date in 1902 was 1.10 and in 1903, the present year, 1.23, thus showing an increase of 23 per cent. in two years. The importance of water power in this system, as well as the present rapid rise of its energy output, is shown by the fact that the kilowatt-hours developed by water power alone during the six months ending June 30, 1903, amounted to 45 per cent. of the entire electrical output from both steam and water power during the year ending on that date.

This increase of energy output has followed a rise in the connected loads of the system as follows:

LOADS, YEAR ENDING JUNE 30.

No. arc lamps.	No. incandescent lamps.	H.P.-motors.	Year.
1,285	41,124	902	1901
1,352	47,579	969½	1902
1,518	50,296	1,400	1903

The greatest gain has been made as to the motor load, for while the numbers of arc and incandescent lamps have each increased about 25 per cent. since 1901, the horse-power of connected motors has risen 55 per cent. This motor load is still on the increase, a contract having just been closed to supply an entire factory equipment of two-phase induction motors with an aggregate capacity of 800 horse-power.

During the year the old electric light station on the bank of the Connecticut River in the heart of the business section of Springfield has been entirely remodeled and is now a brick, tile and steel structure throughout. This building does duty as sub-station for the transmission from the water powers and also contains the auxiliary steam plant, which includes condensing engines of 1,650 aggregate horse-power with their connected generators. Besides the 800 kw added to the generating capacity of the water power stations last year a further increase of 600 kw will be made during the present summer at the Indian Orchard plant. At the steam plant in the sub-station just mentioned are four boilers of 215 hp and three of 300 hp each, all being of the vertical, Hazelton water tube type.

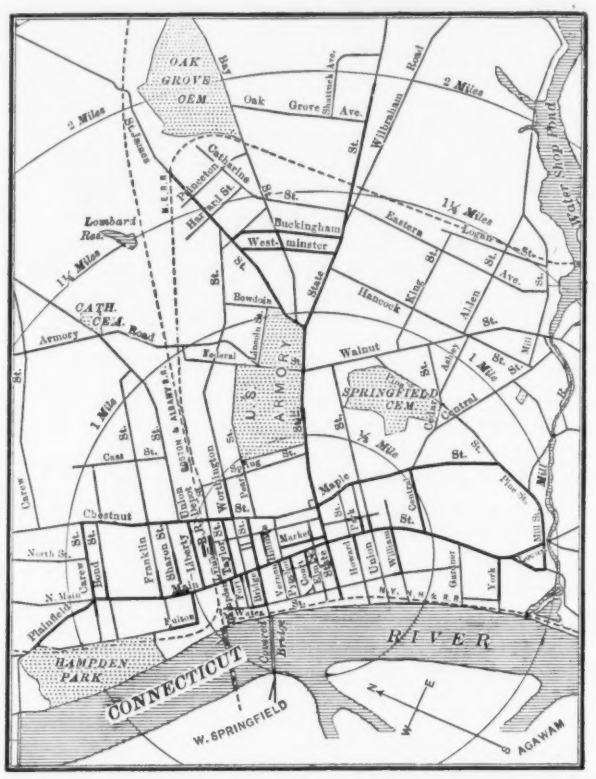
The most notable extension of the Sprinfigeld system during the past year, aside from the very large addition to its motor load, has been in the direction of underground conduits and cables. Though Springfield had a population of only 62,059 in 1900, standing ninth among the cities of the State in this respect, yet as to length of underground conduits and of electric light and power circuits therein it was surpassed by only Boston and Worcester, in 1902. On June

30 of that year the Springfield system included 58,830 ft. of underground conduit containing 303,461 ft. of cable. During the year ending June 30, 1903, there have been added to the Springfield underground system more feet of conduit ranging from 2 to 36 duct, than it had at the beginning, and in this conduit the length of cable installed amounts to 368,706 ft. This cable is all rubber-covered and leaded, and varies in size from No. 8 to 500,000 cm. Both single and duplex cables have been laid, the former for direct-current arc circuits of 10,000 volts, and the latter for two-phase alternating circuits of 2,500 and 6,000 volts respectively. The 6,000-volt cable forms a part of the transmission lines between the water power plants and the sub-station, and the 2,500-volt cable is used in the distribution system.

UNDERGROUND CABLES LAID DURING YEAR ENDING JUNE 30, 1903.

Length in feet.	Size of conductor in cable
13,350	Number 8
158,794	Number 6
94,206	Number 4
6,040	Number 2
206,858	Number 0
13,000	Number 00
852	Number 0000
16,606	500,000 c. m.

The single-conductor, 10,000-volt cable is insulated with rubber to a thickness of 7/32 in. and outside of this is a lead sheath 5/64 in.



MAP SHOWING UNDERGROUND DISTRIBUTING SYSTEM, SPRINGFIELD, MASS.

thick. The 6,000-volt duplex cables have a covering 8/32 in. thick of rubber on each conductor, and outside of this 3/32 in. of lead over all. In the 2,500-volt cable the thickness of rubber on each conductor is 7/64 in. and the lead sheath is 3/32 in. thick.

In connection with the lengths of underground conduit shown in the table, 188 manholes have been constructed. All conduits were laid with vitrified clay duct having 3-in. openings and in lengths of 18 in. In single-duct the 3-in. opening is circular and in multiple duct the openings are each 3 in. square in section.

All conduits were laid on a foundation of concrete 4 in. thick and then the 4-in. layer of concrete was extended over the sides and top of the conduit when completed. Ducts were so laid as to break end joints and with ¼ in. of cement mortar between the different layers. Portland cement was employed for both mortar and concrete, the proportions for mortar being one part cement and two parts sand. For concrete the mixture was one part cement, 3 parts sand and 5 parts broken stone. Broken stone in concrete for use about the conduits was all required to pass through a 1½-in. ring, and for manhole concrete through a 2½-in. ring. In laying multiple ducts a strip of burlap 6 in. wide was dipped in coal tar or neat Portland cement and placed about each end joint. Dowel pins were used at end joints of multiple ducts, the pins extending 3 in. into each duct. The trenches in which ducts were laid had a depth in each case such that the top of the layer of concrete over the completed conduit is 18 in. below the surface of the street. After the completion of the conduits a mandrel 12 in. long and 2⅞ in. in diameter was pulled through each duct.

UNDERGROUND CONDUITS LAID DURING YEAR ENDING JUNE 30, 1903.

Length in feet.	Number of ducts.	Length in feet.	Number of ducts.
9,792	1	124	15
3,101	2	5,485	16
962	3	244	18
9,742	4	6,290	20
18,451	6	690	21
105	7	910	24
310	8	260	25
7,478	9	45	36
4,930	12		
2,530	13		
277	14		

The 188 manholes before mentioned were constructed on concrete foundations 6 in. thick, and the sides of the manholes were 8-in. brick walls laid in cement mortar. Each manhole is provided with a cast-iron frame and cover at the top weighing about 1,000 pounds.

These facts relative to the growth of the system owned by the United Electric Light Company at Springfield have been collected through the courtesy of the manager, Mr. Walter L. Mulligan.

Isolated Plant vs. Central Stations Supply of Electricity. A Suggestion for Obtaining Estimates of Costs on a Competitive Basis.

BY R. S. HALE.

THE question of isolated plant vs. central station supply is one of perennial interest, and is one of which there seems to be no general solution. The operating engineer who is or who expects to be in charge of the heating boilers of a modern building is always sure that an isolated plant is the cheapest for the owner, and so are the salesmen of the machinery, and frequently the architect and consulting engineers, who are to lay out the plant are also in favor of putting in such an installation. On the other hand, the fact that so many large buildings take central station current shows that there are some business men who think the estimates of isolated plant cost are, to say the least, optimistic. Recently the question came up in regard to a building in which I was interested, and a conversation with one of the machinery salesmen suggested to me that the conflicting estimates on the one hand of the central station man, who is sure that electricity from an isolated plant really costs about 20 cents per kw-hour, and on the other hand the estimates of the engineer who is sure that he can run dynamos and engines with no extra labor and save so much coal by using the exhaust steam for heating that the total coal bill with a plant will be even less than for heating alone, could be compared in such a way as to disprove or verify one or the other by bringing them to a basis where they must be backed up by a definite proposal and contract.

The suggestion is that a company might be formed whose business it should be to install and run isolated plants. Such a company would go to the owner of a building and propose a contract as follows: The owner to let to the company space sufficient for the installation of boilers, engines, dynamos, etc., at an annual rental; the company to agree to supply heat, light and power from this plant to the owner of the building and to his tenants.

Such a contract would, of course, be by no means as simple as the contract that the central station man could offer, but the various clauses would involve no insuperable difficulty. In the first place, of course, it must be drawn for a long term of years, the length depending on the expected life of the plant to be installed. Thus, if an owner puts in his own plant he expects to run it for say 10 years and to pay interest and depreciation on it during this time, since

after he has put in his own plant he cannot take it out except at a loss. He should, therefore, be willing to make an equally long contract with the isolated plant company.

The contract might very properly be made with a sliding price, depending on the price of coal. Thus, the price for steam heating might be fixed at 40 cents per square foot, and for electricity at 8 cents per kw-hour on the basis of a price of coal of $4 per ton, with a provision that for every 10 per cent. increase in cost of coal, the price of heat and light should be increased 5 per cent., and vice versa. If the cost of coal should go down, the price of light and heat should be correspondingly decreased.

The contract should provide for a minimum annual payment, which would correspond to the amount the owner would have to allow for the interest, depreciation and care of the plant, which he would have to pay whether he used it or not, and there should also be an upper limit to the amount of light or heat that the owner of the building could require at any one time, this amount corresponding to the capacity of the plant.

In fact, a good lawyer assisted by a good engineer, could easily draw up a contract so that the owner of the building would have no more obligations and no more burdens than if he put in the plant himself. On the other hand, if the owner of the building would let space in his basement for such a company, the company could supply all the heat, light and power that the owner could get from his own plant at rates at least as low as the owner could make it for himself, and show a very good profit. To-day the owner of a building is usually willing to pay the central station 10 per cent. or 15 per cent. more for current than he figures he can make it for himself in a private plant, merely to save himself the trouble of running such a plant. An isolated plant company, on the other hand, could take all this trouble off the owner's hands while still saving to the owner this 10 per cent. or 15 per cent. difference in price, since the isolated plant company would have many sources of saving not open to the owner of the small plant. The isolated plant company would be able to buy all its coal, its oil and all supplies in quantity at a better rate than the independent plant. It would not have to keep such a large store of coal, since in case of shortage it could distribute what coal it could get evenly instead of having some of its plants overstocked and others without coal. Such a company would be able to put an ordinary engineer in charge of each plant, with a first-class man in general charge of several plants to look after the repairs and maintenance of them all, while the owner of a single small plant would have to pay proportionally more for a first-class engineer, who would have to spend a large portion of his time on work that might just as well be done by a cheaper man.

A company running several isolated plants would have sufficient data and experience to enable it to buy the best and most economical form of machinery, while several independent plants each run by the owner of the building who would not be an expert in that line, could not be run so economically.

When it is remembered that all these profits are in addition to the interest and depreciation figured in at the start on the plant, whether put in by the owner or the isolated plant company, it appears that a company engaged in running numerous isolated plants ought to show a tremendous return on the investment besides the ordinary interest and depreciation, and there should be a tremendous field for such companies not only in the large cities, but in the cities of the second class.

Central stations should welcome such a company, since if it be true, as they claim, that the cheapest way of supplying a modern large building is for it to use a plain low-pressure heating system from boilers in the basement for heating only, while buying light and power from the central station, then a company which undertook the whole supply of several large buildings would quickly become the best customer of the central station. On the other hand, if the central station cannot really compete with the isolated plant it had better learn the fact before it invests any more capital in plant and underground mains that will be useless when all current is supplied from isolated plants.

The fact, however, that such companies to run isolated plants have not been started, or at least have not been a permanent success in our cities, is pretty good evidence that the rosy estimates of 1 and 2 cents per kw-hour as the net cost of electricity from private plants are not correct.

Electric Sewage Pumping at Sydney, New South Wales.

For low-level sewage pumping the Sydney, New South Wales, Water and Sewerage Board have gone in extensively for electrical driving. The first electrically-driven plant was put down at Double Bay, the "Shone" system of compressed air ejectors being used, the air compressors being driven by electric motors. The plant is practically in duplicate, there being two air compressors, each of the double-acting duplex pattern, fitted with positive valve motion, making 200 r.p.m. when running at full speed, and having 11-inch cylinders and 18-inch stroke, and fitted with water sprays, cooling jackets, etc. An intermediate shaft is used, to which either or both compressors or motors can be attached by means of special couplings. The connecting rod of each compressor is attached to its respective separate crank shaft. The intermediate shaft runs at a speed of 100 r.p.m., and carries the necessary flywheels and spurwheels. The motors are two 25-hp. Parker make, with toothed core armatures, Eickmeyer winding, and are geared to the intermediate shaft by means of spurwheels and pinions.

The whole plant is designed to work automatically, starting and stopping according to the rise and fall of the air pressure, which in turn depends upon the quantity of work to be done. The principle adopted is the rising and falling of a piston actuating a hydraulic relay; the water is thus admitted into a starting or stopping cylinder, as the case may be, which in turn actuates a rack and pinion, the latter being directly connected to the electrical controller shaft. For the purpose of obtaining the necessary quick movements from contact to contact, the piston travel is so arranged that it is stopped by a die-plate after having reached the end of the predetermined portion of its strike. Having now made its corresponding contact in the controller, the controller spindle cannot again be moved by the traveling piston until the die-plate moves and allows it to travel to the next position, where it is again caught by the plate, with the result that each successive movement from one position of the controller to the next takes place rapidly and with certainty. The blowing out of the arc is accomplished by means of a small air-blast of compressed air, automatically turned on and off by means of a special valve situated in the foot of the controller itself and actuated by the controller spindle.

A set of 230 Epstein cells of 180-hour capacity has been provided as a safeguard against stoppages of the generators, and to provide for the supply of power during such times as the cable engines driving the generators are not running. This plant has been running for over a year now, and has proved so successful, not having required any special attention or repairs of any kind, that the Board decided to utilize electrical driving on an extensive scale, especially as they have been able to obtain power from the tramway power house on exceptionally favorable terms. In future extensions electrically-driven pumps will be used pumping the sewage direct.

The present operations, involving 21 pumping stations, extend along the shore of the harbor from Snails Bay, Balmain to Double Bay. A separate steam-driven plant serves the low lying portions of Marrickville. The largest station, serving as a head station from which all others will be controlled, will be situated alongside the Darling Harbor railway line, close to the Ultimo Power House. Electrically controlled mechanism will be used for indicating at the Pyrmont station the level of the sewage in the receiving wells at the other stations, as well as specially arranged telephonic communication designed so that the attendant in charge may hear the pumps and machinery working at any of the different stations and detect any irregularity in the working. A large subterranean chamber below the street level, which is hewn out of the solid rock, contains the pumping machinery and electric motors for dealing with the sewage from the low-lying portion of Pyrmont and Darling Harbor. Power is supplied here from the Ultimo Power House and distributed to the other pumping stations.

The outlying pumping stations are practically similar to the underground portions of the controlling stations and are of various sizes, according to the area of the district to be served by the station. Some of the stations are situated below the surface of the road, where no other suitable place could be found for it. These consist of a huge caisson built up of cast-iron plates. It is about 28 ft. by 20 ft. wide and 20 ft. high, weighing 80 tons. The interior is oval in shape, and the two ends of the oval are partitioned off by further iron plates, forming two receiving tanks for the sewage, the centre portion being reserved for the machinery. About half

the stations are in hand and several are ready to receive the machinery. The pumps are being manufactured by the Clyde Engineering Company, of Sydney, the motors being supplied by the Westinghouse Company. The overhead material and mains are being supplied by Callenders and Henleys, and the construction work is in the hands of Messrs. Edge and Edge. The Brush Electrical Engineering Company will supply the switchboards and controlling mechanism. The total cost is estimated at about $500,000.

An Object Lesson in Telephone Receivers.—I.

By Arthur V. Abbott, C. E.

An analysis of the telephone receiver indicates that it may be viewed from three different standpoints. It may be considered magnetically, electrically or mechanically. There is no receiver now manufactured which is best from all of these various standpoints, but each one contains certain admirable features which make it superior for a particular purpose, and so the manager of a telephone plant must weigh the various advantages offered by each model and choose that which seems best suited for his particular service. Receivers for local battery exchanges must be utterly different electrically from those designed for common battery installations. Where many toll lines exist, and a large proportion of the business is long-distance work, a type of receiver entirely different in design, both electrically and magnetically, is desirable from that which is sufficient for the country village whose conversations are relatively of less importance and never traverse more than a mile or two of wire. Mechanically, the highest types of receiver are more expensive to construct, produce better results and last longer than the cheaper varieties. Naturally a small country exchange, whose subscribers cannot be reckoned by hundreds, can use a type of receiver which would not be tolerated by the city plant having tens of hundreds of subscribers.

Viewed from the standpoint of the magnetic circuit, receivers may be subdivided into four classes:

1st. Single-pole receivers.
2nd. Double-pole.
3d. Single-bar magnets.
4th. Laminated magnets.

Electrically, according to the design of switchboard into which receivers are to work, there are two divisions:

1st. Local battery receivers.
2nd. Common battery receivers.

Mechanically, it is possible to class receivers into two divisions, depending upon the method of assembling.

1st. Receivers in which the magnetic system and diaphragm are rigidly connected together, independently of the case, and

2nd. Those in which the case forms the supporting foundation for the entire mechanism. Under the two classes of this division there are two sub-classes, namely, (*a*) receivers with external cord connections, and (*b*) those with internal cord connections.

Now it is proposed to examine and describe a few of the more familiar types of receivers with the view of ascertaining the present status of the art of receiver manufacture. As comparisons under all circumstances are invidious, none will be drawn, though subsequently methods of testing, applicable to both transmitters and receivers, will be developed, whereby performance of either the receiver or transmitter may be tested and conclusions formd as to the type of service to which any particular instrument is best fitted. Manufacturers are constantly improving in the art of receiver building, and the receiver itself is so complex a machine that even with the most perfect system of interchangeable manufacturing it is difficult to produce two instruments that are exactly alike; nor has interchangeability in the building of receivers been carried to anything like perfection that is witnessed in watch works, the sewing machine factory or a gun shop; and so, while the models described may be taken to be fairly representative of the art of receiver building, it is quite certain that other examples from the same shop may differ considerably in many of their properties.

THE HAND RECEIVER OF THE AMERICAN TELEPHONE & TELEGRAPH CO.

The first models of the receiver manufactured by the American Bell were of the single-pole variety, shown in Fig. 7 (see page 687, Electrical World and Engineer, April 18, 1903). This design has been so universally supplanted by the bipolar type that the earliest form is merely of historic interest. The bipolar receiver is shown by dimension drawing and sectional photograph in Figs. 8 and 9 (page 687, Electrical World and Engineer). Further details appear in Figs. 32 and 33. The complete receiver, as it is usually met with in practice, is given in Fig. 32, while in Fig. 33 the instrument is dissected. The case is made of hard rubber and consists of three parts: the body, *A*, Fig. 33, the tail piece, *B*, and the diaphragm cap, *C*. The magnetic system shown at *D* consists of two rectangular bars 3¼ in. long, the outer corners of which are chamfered. The bars are .63 in. wide and .26 in. thick. At the rear end the bars are

FIG. 32.—ASSEMBLED BELL RECEIVER (COMMON BATTERY TYPE).

bolted together with a soft iron filling piece and iron bolt, while in the front the filling piece and bolt are of non-magnetic material. Between the bars a lead weight is cast, so that the receiver may be sure to hold the hook switch in proper position. At the front end the filling piece carries a screw thread whereby the entire magnetic system may be secured in the body of the case in which a similar thread is cut. The pole pieces are recessed between the front filling piece and the magnets and all clamped by a substantial bolt. The magnet bars are placed ½ in. apart and exercise a tractive effort of 1.13 pounds (588 grams). The sectional area is about .164 sq. in. (1.06 sq. cm.). This corresponds to a tractive effort of 550 grams per sq. cm., which would indicate a remenance of 4,200 gausses. The pole pieces are set ½ in. apart centers. They are .54 in. wide, .086 in. thick and 1.36 in. long, giving an area of .046 in. (.3 sq. cm.) so the pole flux would be 9,800 gausses. The coil spools are .09 in. long, .40 in. wide and .43 in. deep, made of brass, giving a winding volume of .06 sq. in. (.385 sq. cm.). The winding is No. 34 or 36 B. & S. silk-covered copper wire, for the common battery receivers, both coils being connected in series. The usual resistance

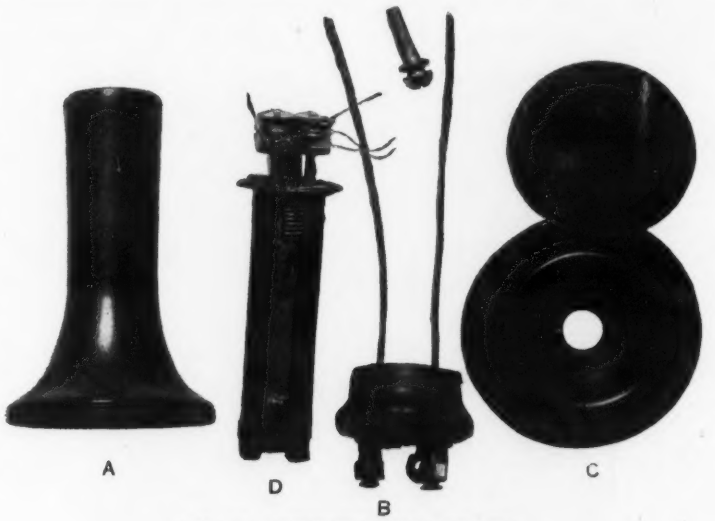


FIG. 33.—DISSECTED BELL RECEIVER.

is about 60 ohms, but receivers are wound as low as 20 ohms and as high as 75. For local battery stations the winding is one or two gauges finer and the resistance carried to about 100 ohms. The diaphragm is of ferrotype metal No. 31 B. W. G. .01 in. thick, 2.25 in. in diameter over all, with a free diameter of approximately 2 in. As a protection from moisture, the diaphragm is thoroughly varnished. The body of the case is faced presumably at right angles to the thread cut to hold the magnetic system, and the magnets screwed into the case till the pole pieces are from 1/64 to 3/64 of an in. away from the diaphragm. Upon the outside of the tail piece, *B*, a pair of binding posts are placed, to which leading-in wires of cotton-covered copper are soldered and extend alongside of the magnetic system through a fibre disk which is placed just beneath the pole pieces and are soldered to the ends of the line coils. Thus

it is impossible to take the receiver apart without unsoldering some of the electrical connections. The tail piece is secured in place by being slipped over the end of the case body and held by a screw that is tapped into the rear of the magnet. The mouth of the Bell receiver noticeably flares much more than most of the other models and the resonant cavity enclosing the diaphragm is considerably larger. Fig. 34 is a phantom of the Bell receiver with the diaphragm removed. The field is quite uniform and symmetrical, but not sufficiently intense to affect the iron filings over the entire area of the plate. Fig. 35 is a phantom with the diaphragm in place, from which it appears that the field is fully sufficient to saturate the diaphragm at least in the immediate neighborhood of the pole pieces. The diaphragm, as in most models, is secured between the cap and the case by a screw thread on the exterior of the case, consequently adjustability is attained only by loosening the tail piece screw, and moving the magnetic system in and out of the case by means of the screw thread which holds it in place.

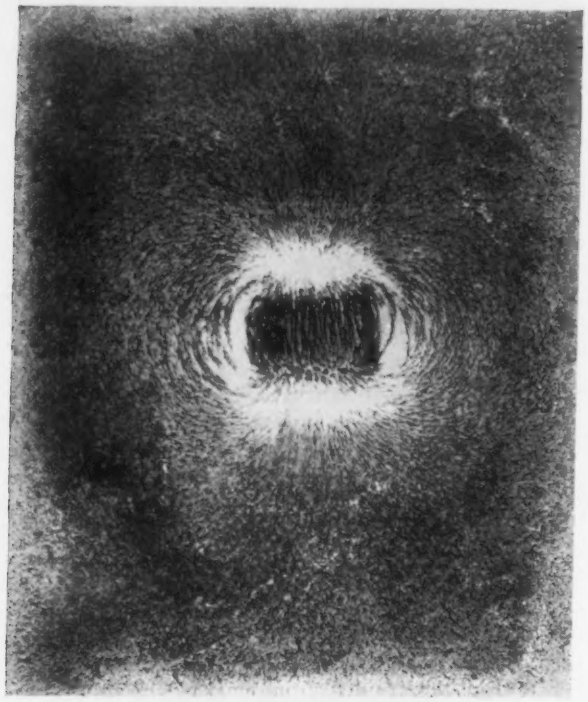


FIG. 34.—PHANTOM WITHOUT DIAPHRAGM. BELL RECEIVER.

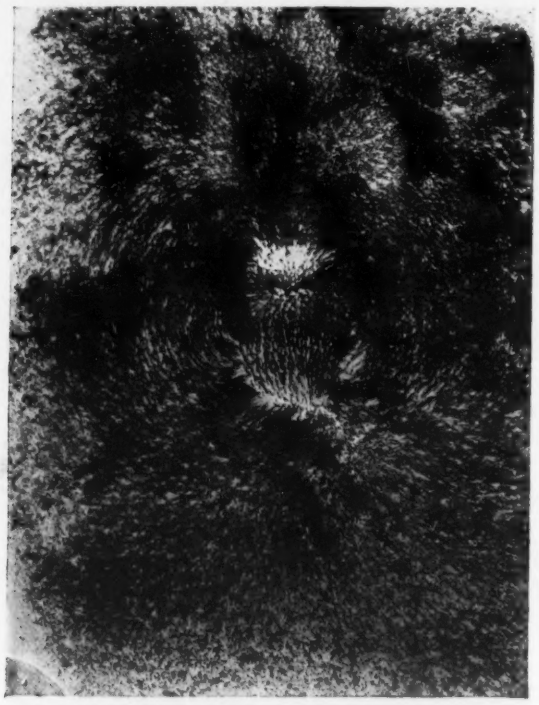


FIG. 35.—PHANTOM WITH DIAPHRAGM. BELL RECEIVER.

THE HEAD RECEIVER OF THE AMERICAN BELL.

When a receiver is in constant use it becomes burdensome to constantly hold it to the ear, and it is customary to build a very small and light instrument, which may be supported on the head by means of a band or cap, and thus adjusted to the proper place at the ear, leaving the hands free to follow other avocations. Such telephones are a necessity to switchboard operators. One of the models of this form of receiver manufactured by the American Bell is illustrated in Figs. 36 to 41, inclusive. The assembled receiver is shown in Fig. 36. In Fig. 37 the cap and diaphragm are removed, while in Fig. 38 the instrument is dissected. The receiver case consists of a light shell of pressed brass, about the size of a watch case, and so these instruments are frequently denominated "switch watch receivers." The case is about 2 in. in diameter and 11/16 in. deep. The edge of the brass case is chamfered to form a bearing for the diaphragm, and on the exterior is a screw thread engaging with the rubber diaphragm cap. The magnetic system consists of two bars of steel ⅛ in. thick, 7/16 in. wide, forged into circular segments as shown in Fig. 39. The laminated magnet thus formed is placed

FIG. 36.—HEAD RECEIVER ASSEMBLED.

FIG. 37.—CAP AND DIAPHRAGM REMOVED.

on the bottom of the brass case and secured thereto with one screw. To each end of the magnet a soft iron pole piece is attached which, as is seen in Fig. 38, extends inwardly towards the center of the magnet, and is there turned upwards at right angles. The pole pieces, .357 in. wide, .085 in. thick and ½ in. deep. Upon the pole pieces the line spools are placed made of brass .37 in. wide, .68 in. long, and .31 in. deep. The spools are usually wound with No. 38 wire to a resistance of about 60 ohms. Between the ends of the magnet a fibre block is screwed to the case, to which the terminals of the line coils are attached. The receiver cord is often made of

FIG. 38.—HEAD RECEIVER DISSECTED.

two strands, each of which carrying its appropriate tip that passes through a hole on the side of the case, and is clamped in the fibre block by means of two screws (Fig. 38) that connect the tips with

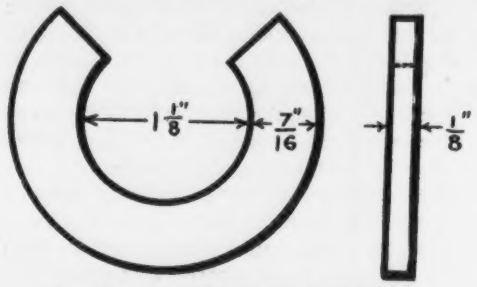


FIG. 39.—MAGNET OF HEAD RECEIVER.

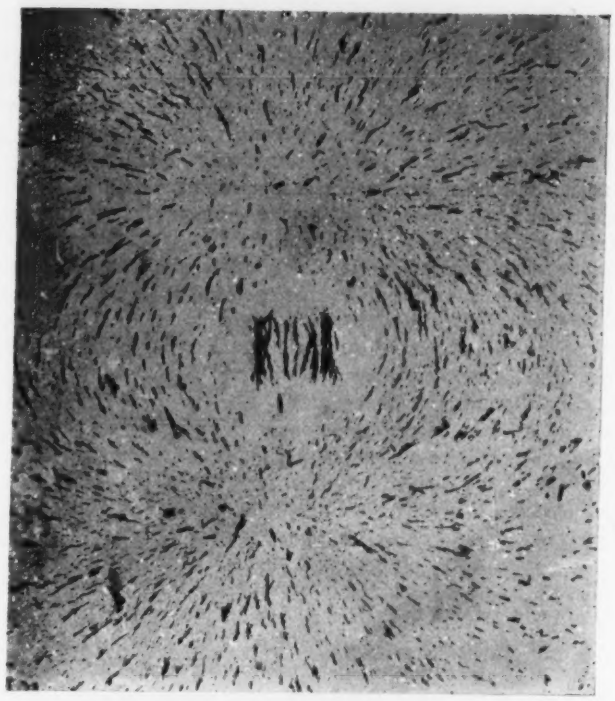


FIG. 40.—PHANTOM OF HEAD RECEIVER WITHOUT DIAPHRAGM.

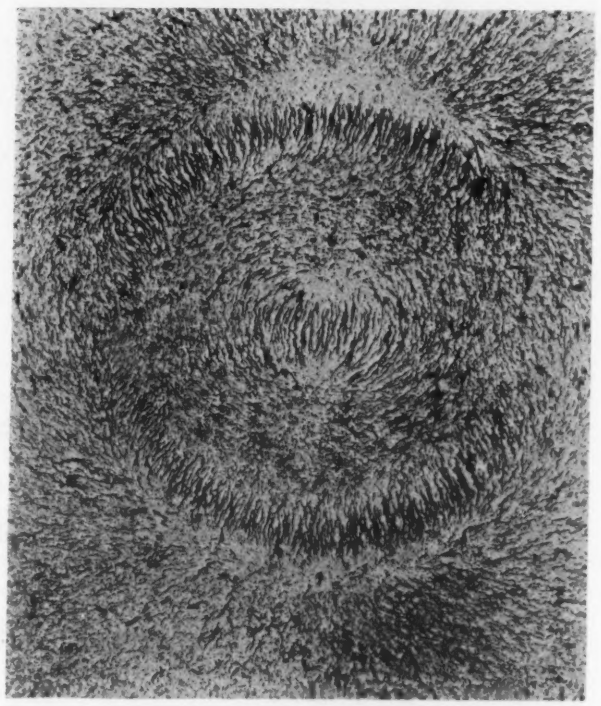


FIG. 41.—PHANTOM OF HEAD RECEIVER WITH DIAPHRAGM.

the terminals of the line coil. The diaphragm is of ferrotype metal .01 in. thick, 2 in. in diameter over all, with a free diameter of 1.93 in.; the diaphragm is perfectly flat. The magnets of this receiver exercise a tractive effort of 1.313 pounds (477 grams). This corresponds to a tractive effort of 690 grams per sq. cm., and indicates a remenance of 3,500 gausses. The weight of the entire receiver is 5½ ounces and is not an uncomfortable burden even if constantly worn against the ear. Fig. 40 is a phantom of the magnetic system with the diaphragm removed, showing an evenly distributed though not very intense field. Fig. 41 is a phantom with the diaphragm in place. At first sight this phantom appears curiously, as there is distinct evidence of the magnetic field around the circumference of the case. A little consideration, however, shows that this is caused by leakage from the circumference of the circular magnets to the diaphragm, and thence through the diaphragm to the pole pieces in the center. Apparently the pole piece system is hardly sufficient for the magnetic flux impressed upon it, and possibly to augment this portion of the magnetic circuit might somewhat improve the efficiency of the receiver, but it is difficult in so small a space to secure a design which is desirable from all standpoints.

Traction Developments in Chicago.

Plans for the consolidation of the Union Traction, City Railway and other companies have recently been discussed in New York. A basis of one-city-one-fare is considered by the receivers to be the best foundation upon which to ask franchises of the city. Its details will probably be worked out by protective committees representing the North, West and other companies, together with a so-called voting trust, with power to act for the Union Traction Company. It is not believed that the one-city-one-fare arrangement would be a heavy burden upon the consolidated company, as it is thought that through travel between the various sides of the city will be comparatively light.

As an immediate result of the conference of the officials in New York, promises for better accommodations for Union Traction passengers are held out. General Manager Roach estimates that the cost of more cars and better facilities demanded by Judge Grosscup will be some $600,000. His estimates are as follows:

100 new double-truck, modern electric motor cars, capable of seating 65 persons each	$480,000
Replacing cables with electricity at the outlying ends of several cable lines	67,000

The general manager figures out that with this added electrical equipment and the new and commodious cars, he can increase the accommodations given the patrons of the road to a marked extent. He can relieve the cable loops in the down-town district of many cars they are now carrying by running them in over rails now seldom used, but at the same time make possible the use of more cars on these loops during the rush hours, by taking off the cable lines burdens in the way of long-haul cars they are now bearing in the outlying districts. It would be, of course, necessary to get the approval of the city, but it is not thought there will be any difficulty in this, in the face of the improvement in service the company expects to be able to show.

Improvements which will improve the capacity of the union loop by 35 per cent. and add greatly to the convenience of the traveling public, have been outlined to Commissioner Blocki. The improvements depend upon an extension permit for station platforms, to be sought from the city council. The companies promise to install moving stairways at State, Dearborn and La Salle Street Stations, and eliminate the grade crossings at Fifth Avenue and Van Buren Street, where the Metropolitan trains enter the loop. It is further planned to improve the station near Clark and Lake Streets, and to elevate the outer track from Madison Street and Wabash Avenue to Quincy Street and Fifth Avenue.

Modern Science Club.

On September 8 there will be a general discussion of the subject of electric elevators before the Modern Science Club, 125 South Elliott Street, Brooklyn, N. Y., and some short papers on the same theme are to be read. On September 22 Mr. J. A. Anderson will give a lecture on the Eastern Power Station of the Brooklyn Rapid Transit Company. Mr. R. Henderson is secretary of the club. A smoker is scheduled for September 15.

Reporting the Yacht Races by Wireless Telegraphy.

FIG. 1.—YACHT "CHETOLAH."

One of the most interesting features of the recent international yacht races between the *Reliance* and *Shamrock III.*, off Sandy Hook, for the America cup, has been the use of wireless telegraphy for reporting events "at the front." It will be remembered that efforts in this direction had been made at previous races, but the preparations on this occasion were upon a far more elaborate scale, and should have been attended with greatly improved results. But if there is one thing at present apparent, it is that in multitude of coherers there was dire confusion; while if all the statements made are true a great deal of the interference was outrageously malicious. So far as can be seen, present appliances or methods of tuning are not adequate to suppress or ignore interference of this character whether malicious or not, but statements made by Mr. Marconi and Mr. Edison indicate that both inventors will bend their energies jointly to overcome this difficulty.

So far as could be ascertained there were at least three systems busy during the races, the Marconi, the De Forest and the International or Gehring, the first-named being installed on the Associated Press boat, *Chetolah,* where ELECTRICAL WORLD AND ENGINEER had an opportunity to watch its working. To receive its dispatches, there were the existing stations at Babylon, Long Island, and Sagaponnack, Long Island, while a new station was put in operation at South Jamaica, L. I. The De Forest system was installed on the Lipton steam yacht, *Erin,* as recently described in these pages, and also on

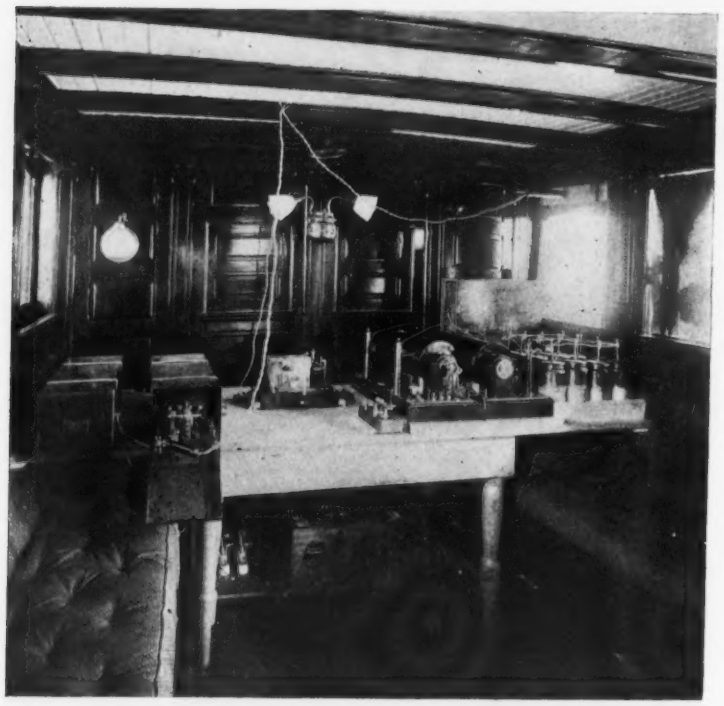


FIG. 2.—WIRELESS TELEGRAPH EQUIPMENT ON "CHETOLAH."

a tug, with a land station at Coney Island. The Gehring system was on a towed schooner, with a land station on the New Jersey Highlands. Possibly many other receiving stations were at work, and Professor Fessenden is understood to have had one at work successfully at Jersey City; but it is obviously impossible to know all who are "rubbering" wirelessly, whether from curiosity or from other motives.

Views are shown herewith of the Marconi equipment on the *Chetolah,* operated by Mr. Newman. When seen on Thursday, August 27, the plant had been extended so that two "tunes" were available, the object being to overcome, if possible, the interference which had spoiled much of the good work done earlier, and which at the race just preceding had rendered reception almost out of the question. During Thursday, twenty Associated Press messages were sent from the open sea, the beat fifteen miles to windward taking the *Chetolah* between 30 and 40 miles from the land stations. Each message was sent three times on each tune, so that actually 120 messages were sent to shore. Once in a while the receiver was cut into circuit, when the tape record would indicate pretty clearly that some one in the vicinity was trying his best to "jam" the system by heavy current, or was interjecting meaningless matter, although the intelligence of a wireless company thus deliberately "fouling its own nest" would appear open to doubt. The results obtained, however, despite the interference were quite good as compared with some of the previous records, and Mr. Charles H. Boynton, the efficient superintendent of the Eastern Division of the Associated Press, who watched the situation with much interest, said: "Whether there was less interference on the part of the competing wireless telegraph companies to-day, or whether the changes made by the Marconi Wireless Telegraph Company to overcome the interference which interrupted their service of the yacht race on Tuesday were successful, I am not in a position to positively say, but the result was certainly a great improvement. The officials of the Marconi company told us yesterday that they would utilize in to-day's race a change of system, which they hoped would permit them to send their messages through whatever interference they might meet, and this change, which naturally they do not care to make public, was operated to-day. Twenty bulletins were sent from the Associated Press yacht, *Chetolah,* and of these we received fourteen, though some were delayed in coming through. On the whole the service was fairly satisfactory, and kept us posted on the progress of the race."

As to the troubles of the earlier days, Mr. Bentley, vice-president of the Marconi Wireless Telegraph Company, has issued a formal statement in which he said: "The reason for the falling off in efficiency is this: While we have been able, by means of our improved apparatus, to cut out six of the seven competing stations, one high power land station has been able to disturb us. The proprietors of the high power station switched in more power, and from 9 o'clock in the morning until 5 o'clock in the evening incessantly kept the station key rattling out "A B C, A B C, A B C," except when varying this monotonous programme with meaningless phrases. On Thursday and Saturday of last week the erudition of the operator was more clearly disclosed by obscene expressions. On Saturday we received from the troublesome high power station a considerable part of 'The Wreck of the Hesperus.' During the races the *Chetolah,* with our apparatus aboard, was for the greater part of the time in hailing distance of the three boats carrying apparatus of the other companies. This we were prepared for, since the president of one of the companies had threatened to 'put us out of business.' This we knew he could not do with any apparatus he could put on a vessel. The threat of the individual referred to, made to a third person, can be verified by affidavit when required."

Telephony in Michigan.

The reports on file in the office of the State Auditor-General, at Lansing, Mich., of gross earnings for 1902 show that the 47 independent companies earned $532,126.80, while the Michigan Telephone Company, Bell system, earned $1,426,061.24. The independent companies paid in taxes about $15,000 and the Michigan company $45,000. The total value of the physical property of the independents, as shown by the report of the tax commission, is $1,000,000, and of the Michigan company $5,000,000. These are the figures prepared by Prof. M. E. Cooley in 1900. Since then the Michigan company has made improvements and extensions costing more than $1,000,000.

The location of the independent lines shows that they have very little bearing upon the business of Detroit. The principal one is the Citizens', of Grand Rapids, which owns exchanges in that city, Lansing and Battle Creek, in every one of which cities the Michigan company has larger exchanges, Grand Rapids and Detroit being connected by ten circuits. Port Huron, Mt. Clemens, Ann Arbor, Ypsilanti, Monroe, Wyandotte, Lapeer and Kalamazoo have only the Michigan company's system. Pontiac is the only important city near Detroit that has an independent exchange, but that city has

over 700 Michigan telephones. Of the 47 independent companies, the Michigan company has contracts for exchange service with about 10, among which are Tecumseh, Marine City, the Moore system operating in the Thumb, Cheboygan, and the new system operating a toll line between Bay City and Alpena, and an extensive system at Cassopolis.

Recent Electrochemical Developments.

RECOVERING TIN FROM TIN SCRAPS.

Two patents were granted on August 25 for improvements in the method of recovering tin from tin scraps by electrolysis. Messrs. Martin Laernoes and John Dunn, of Streator, Ill., patent mechanical details of construction of a sheet-iron cathode for such processes, the object being to make the plate more durable and to facilitate the removal of the tin deposited on the plate.

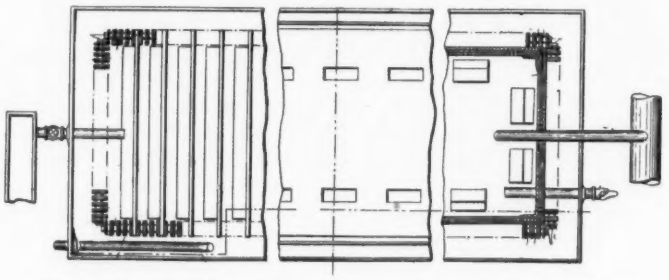
A new process for recovering the tin from scraps, patented by Mr. B. A. Bergman, of Ryfors, Sweden, involves two steps. The first step is the dissolution of the tin in caustic alkali. This is accomplished by making the basket, containing the tin scraps, one electrode in a cell, while finely divided copper oxide is the other electrode, caustic alkali being the electrolyte. This combination acts as primary battery, quite analogous to the Edison-Lelande cell, if tin is substituted for zincs. The process during discharge is the solution of tin to form stannate of the alkali and the reduction of copper oxide to copper. The electrical energy generated in this manner may be stored up in a storage battery. This is the first step, the result being the solution of tin in caustic alkali. The second step of the process consists in drawing off the solution and recovering the tin from it by well-known processes. The finely-divided reduced copper is re-oxidized by glowing in a current of air.

PRODUCTION OF CHLORIDES OF CARBON IN THE ELECTRIC FURNACE.

A patent granted to Dr. F. J. Marhalske, of Chicago, for producing chlorides of carbon in the electric furnace, describes a process of purely chemical nature, the electric furnace being used only for the production of the required high temperature. The charge consists of a mixture of broken coke, sodium chloride and silica sand. The chlorine combines with the carbon and the resulting carbon chloride is withdrawn and may be condensed. Various chlorides of carbon may be produced by varying the proportions of the ingredients of the charge.

DIAPHRAGM PROCESS FOR THE PRODUCTION OF CHLORINE AND CAUSTIC ALKALI.

Most of the larger paper and pulp mills have begun to install in recent years electrolytic plants, for the production of bleaching powder for their own use. All of them use diaphragm processes, but the construction of the cell is different in different plants. A



APPARATUS FOR PRODUCTION OF CHLORINE AND CAUSTIC ALKALI.

patent for a new diaphragm cell was granted on August 25 to Mr. A. B. Larihar, of Oldtown, Me., the patent being assigned to the Penobscot Fibre Company, which has conducted a number of experiments with such processes in recent years.

The special feature of this new cell is the cathode, which is of peculiar construction. It consists of a grating forming a complete enclosure, constituting the side walls of the cell. This grating is in sections, forming the four sides of a parallelogram and secured together at the corners by posts of angle iron. The polygonal enclosure thus formed serves not merely as the cathode, but possesses sufficient rigidity to act as the wall of the cell, supporting itself and the diaphragm which is stretched upon it, and also the cover of the cell from which the anodes depend.

The grating which composes the cathode consists of a series of vertical bars or slats of soft steel. The slats are spaced uniformly apart, so that a lamellar cathode is formed which divides the solution into a great number of films which pass from the diaphragm out through the cathode into the receptacle which surrounds the cathode. The floor of the cell is formed of Portland cement. The diaphragm consists of asbestos paper, several thicknesses of which are placed around the walls of the cell so as to break joints with each other, each layer forming a lap-joint with itself. The anodes consist of a series of graphitized carbon slabs.

Brine is supplied to the interior of the cell, which represents the anodic compartment. The caustic soda solution escapes from the outside reservoir through an overflow pipe, which is adjustable, so that the surface level of the liquid in the outside reservoir may be changed at will. By maintaining the inside level (anode compartment) slightly above the outside level, it is possible to counteract the tendency of the O H ions to come over from the cathodic into the anodic compartment and there cause trouble. In this the inventor applies the old method used by Le Sueur in his early pioneer work.

In the adjoining diagram on the right end of the cell the cover and upper portion of diaphragm are removed. The left end is a horizontal section taken in the plane of the top of the tank, with the diaphragm omitted; the middle part has the cover on.

Electrically Operated Swing Bridge at Sydney, New South Wales.

An electrically-operated swing bridge is being installed at Sydney, New South Wales, to replace the present Pyrmont bridge. The existing bridge, which was opened for traffic in 1857, has very little head room, and has to be opened for anything larger than a row-boat. The new bridge is to have headway of 26 ft., which will allow a number of smaller vessels to pass under and materially reduce the number of times daily that the bridge has to be swung. The swing span of the new bridge will be 225 ft. long and 54 ft. wide, and will weigh 600 tons. The swing is of the ring-bearing type, and the whole weight—some 800 tons when swinging—is distributed by an arrangement of girders to 16 points on the drum, thus insuring an even load on 66 cast steel rollers upon which the span travels.

Two 50-hp. motors will be provided for operation, and it is estimated they will either open or close the bridge in sixty seconds. Both slewing and end-lift motors will be carried on a platform inside the drum, the former working, through a chain of gears, a vertical shaft, on the lower end of which is a cast steel pinion meshing with a cast steel rack secured to the top of a pivot pier, while the end lift will be effected by means of cones on horizontal shafts worked by a 35-hp. motor gearing to a longitudinal shaft running the whole length of the pier. The whole of the operations connected with the swing span and the gate on the side span will be controlled by one man from the controller house over the footpath of the centre of the swing span. The new swing will afford two clear fairways of 70 ft., as against the 57 ft. 6 in. and 35 ft. openings as at present.

Electric Railway Progress in Japan.

Mr. Fukutaro Yuhara and other gentlemen, who are backed by certain capitalists of Tokyo, have applied to the authorities for permission to construct an electric railway between Atami and Odawara with a capital of 500,000 yen. There seems to be little hope of the proposal being sanctioned by the authorities, unless an amalgamation is effected between the proposed company and the "Hand-pushed Car" Company, now carrying on business in the locality.

The application to the Metropolitan Police authorities of the Tokyo Electric Tramway Company for power to increase its passenger fares has been refused. The subject has naturally attracted a great deal of attention in Tokyo, and the decision of the authorities will no doubt give much satisfaction to the public.

With a view to making connection with the electric railways in Tokyo, the Keihin Electric Railway Company has, it is reported, decided to diminish the width of the gauge to 4 ft. 6 ins., against 4 ft. 8.5 ins., and has already applied to the authorities for permission to do so. It is also reported that the company intends to employ a number of large passenger cars, 44 ft. long.

International Association of Municipal Electricians.

The eighth annual convention of the International Association of Municipal Electricians was held at Atlantic City, N. J., September 2, 3 and 4. The attendance was large and indicates a steady growth in the organization. Members of the Association were present from all parts of the country, and a number of interesting papers were read and discussed.

The meeting was called to order Wednesday, September 2, in the large convention hall of the Hotel Rudolf, and the delegates welcomed to the city by Mayor Franklin P. Story, of Atlantic City. Suitable response was made, and the business of the convention was taken up.

Mr. Osborn H. Hatch, of Detroit, Mich., contributed a most interesting paper in which he urged that the municipal electrician should not only make a record of every official action, but also of conversations having relation to his duty. The paper includes a set of rules and regulations for the construction and maintenance of electrical wires, which might well serve as a substitute for many similar sets of rules perfunctorily prepared and now in use. A system is also sketched upon which to base city reports and another relating to details connected with new work and repairs and for keeping track of work. The paper includes a number of tables and diagrams explanatory of the text.

Mr. W. H. Thompson, of Richmond, Va., in a paper dwelt upon the importance of the fire alarm and police telegraph to municipalities. He shows how, with a proper fire alarm system, the losses caused by fire may be greatly reduced, and points out the benefit of a police patrol system to a community.

Mr. Henry W. Pope read an interesting paper entitled "The Economy of Time," in which he elaborated upon the importance of the telegraph and the telephone in modern life. As an instance of a new use of the telephone, he told of a case where a farmer arranged with the postmaster to open and read his important communications to him by telephone. This resulted in some official correspondence as to the propriety of the action of the postmaster, but the latter was tacitly sustained. Mr. Pope says that this practice has now gone into considerable use, and he considers that eventually some provision may be made for the regular transaction of business in this manner.

Referring to the time lost in sending to and from offices telegraph messages, he suggested the use of blank forms for the reception of the type-written message which would admit of being folded and sealed to show the address, eliminating the necessity of an envelope and the labor, time and expense involved in providing and addressing it; or an envelope with a space cut out of the face side and covered with transparent paper so that when the telegram was properly folded the address would be visible from inside the sealed receptacle.

In filing the telegram for transmission thus prepared, the sender should be asked to elect whether delivery should be by messenger or telephone, and this indicated by some character or symbol would be the authority for the distant office. Every business man, every business office or factory of any account in the United States has a telephone, and this will be true to a considerable extent with residences and farmers in the near future. As the public became apprised of the feature, the messenger would be gradually relegated to other fields of industry and the greatest element of delay eradicated.

There are other details, that of copying, for instance, that seem unnecessary in the days of typewriting. It would seem as if the original always accessible was sufficient, and that danger of trouble or loss from errors or omissions, which are limited to the tolls paid under most conditions, are insignificant in comparison with the benefits derived in the saving of time and labor.

Mr. Pope considers that the time is not far distant when the existing conditions with regard to the collection and delivery of telegrams, or even the more improved conditions suggested, in which the telephone is utilized, will be considered indirect and cumbersome to large commercial users of the telegraph—unable for one reason or another—expense principally—to avail themselves of the advantages of a private wire. The demand for a service that will fill many of the requirements of a private wire and reduce the time element still further will bring into use an automatic service which will be in entire control of the sender and receiver of communications, as is the case to-day with the long-distance telephone service, the company performing no part of the operating service in the actual transmission and reception of the message, except furnishing and maintaining the wire and apparatus.

The almost general use of the typewriter with its universal keyboard and its skilled attendant meets the operating problem, and it is easy to conceive, that with a simple operating or punching mechanism this employee is in training to become the operator of the future in punching, transmitting and translating type, or for the work of operating simple printing devices or any device possible of operation with a universal keyboard. The connection would be put up on order as is now done in a telephone transaction. The message having already been prepared by the stenographer or typewriter, is then transmitted through to the distant customer at the rate of hundreds of words per minute, and there translated by the customer's employee. The charge for this service, in which the company or its employees take no part, other than in providing the circuit, leasing and maintaining the apparatus and putting up the circuit on demand, would naturally be by the period of time occupied, which would seem a possibly cheaper method than the present telegram charge, in that the labor of operating is borne by the customer and the limit as to the number of words is practically removed.

All telegraphers understand why the Morse holds its own against all suggested automatic schemes. It is because of the delay intervening in preparing and translating. The automatic, as we understand it to-day, is a wire economizing device more than anything else. The scheme outlined eliminates, so far as the company is concerned, the time and inconvenience of preparation and delivery—the labor and stationery—of an ordinary telegraph transaction. Mr. Pope said he has often wondered why this sort of a system has not suggested itself as of sufficient importance to justify an experimental trial. It seems a perfectly feasible and practicable way to economize time and labor now that we have reached the era of copper wire and high type of construction.

Mr. Pope advocated the installation of private branch exchanges with ample trunking facilities where the telephone is largely used. Interior service between stations is free and unrestricted. The chief officer is within speaking distance of every department or subordinate, it being no more trouble to open up a conversation than to put on a hat, and the time usually occupied and the inconvenience experienced in running to and fro—from one department to another—is saved. Some corporations go so far in the broadening of this system as to provide telephones for their clerks, maintaining that the convenience and time saved justifies the expense, which at best is nominal after the exchange is once established. Such an exchange is a clearing house and information bureau for all citizens having business with city departments, the operator under your own jurisdiction being able to direct and distribute inquiries to the proper department.

It does not follow that the installation of a private branch exchange involves increased telephone expense. Oftentimes a considerable saving can be effected by the elimination of high-priced direct exchange connections and passing such service through the private exchange. Such an exchange operated by one's own employees could handle fire and police calls originating through telephone channels with absolute reliability and promptitude. With direct trunk wires, for emergency purposes only, from each city exchange to this private branch exchange, it must be obvious that the field of operation and protection would be enormously increased and extended.

Many of the manufacturers of electrical apparatus and supplies were present, or had their representatives on the scene.

Frederick Pearce, of New York, who has not missed a convention of this body since its inception, was present and greeted his friends.

Mr. J. Jones, Jr., of J. Jones & Son, New York, was most assiduous in his attention to all visitors, and talked persuasively of the merits of his various lines.

The American Circular Loom Company was ably represented by Thomas H. Bibber, of Boston.

The Okonite Company sent Romaine Mace, of the New York office, to represent its interests.

The Gordon Battery Company, New York, had in attendance Mr. Banks, of the New York office, who had just returned from a successful Western trip. The Gordon battery, he reports, continues to grow in favor everywhere.

The Saratoga Convention of the American Street Railway Association.

In accordance with the programme, the twenty-second annual convention of the American Street Railway Association was held this week at Saratoga Springs, N. Y., and it was still in active progress when this issue of ELECTRICAL WORLD AND ENGINEER went to press. At the same time the Street Railway Accountants of America held their seventh annual convention and the promising American Railway Mechanical and Electrical Association, formed last year, held its first annual meeting. It is needless to say that the call of the great parent association and its subordinate bodies was responded to very generally, with the happy result of a gathering fully equal to any of the past in size and importance.

Many members arrived early and by Wednesday the various hotels were overflowing with the street railway contingent arriving from all parts of the country, and the badges were much in evidence, not only at the Grand Union headquarters, but on the piazzas of Congress Hall opposite, in the parlors of the United States or the corridors of the Kensington. Lively, animated throngs were to be seen everywhere of those whose names are prominently associated with the industry of such marvelous electrical growth and with the allied enterprises from which it draws materials and supplies.

By a fortunate inspiration, the Association, instead of bunching the exhibitors into frowsy bedrooms and fusty basements, had taken title in their behalf to the broad stretches of turf and adjacent balconies; and there the exhibitors had set up their booths, giving the impression of an outdoor fete. It may indeed be questioned whether the exhibits at a street railway convention were ever grouped before in such a picturesque fashion. Some of the booths, too, were quite ornate and elaborate, but others were decidedly of the camping-out kind, which but for the providential turn of the weather might have resulted very disastrously and pneumonically for the al fresco show men. Elsewhere in this issue further reference is made to the individual displays, it being intended here merely to record the general nature and effect of the exhibit side of the convention. The pretty daylight scene was, if anything, outdone by the night views, when brilliant electrical signs were lit up and when the spray of the big fountain showed up in prismatic colors under the dazzling beams of the searchlight.

The first of the conventions to assemble was that of the American Railway Mechanical and Electrical Association, which gathered in one of the cosy "club" rooms in the wings, and which, by the largeness of the early attendance as well as the earnestness and enthusiasm of the delegates, showed how active is the interest in this body, the right "A. R. M.," as it is already facetiously called, of the old parent body, these being some of the initials in its long name. The meeting was called to order by President Farmer, who delivered an excellent practical address, in which he put the membership at 85, and indicated how large is the field of possible usefulness. The paper first taken up was that of Mr. C. F. Baker, of the Boston elevated system, dealing with the "Care and Maintenance of Car Bodies," he being superintendent of shops and machinery of the road. As a matter of fact, this extremely practical and sensible paper dealt largely with car painting, which was freely discussed by the members, but it soon drifted into the other and larger subject of car wiring and insulation, to the consideration of which a number contributed in a long and able exchange of views and data, among the speakers being Messrs. Libby, Lindall and Ballard, of Boston; E. W. Olds, of Milwaukee, and Alfred Green, of Rochester.

Mr. Lindall said that he had been much impressed with the agitation over the late sad disaster in the Paris Underground, and had himself for some time past given great attention to the fire-proofing of cars on the Boston "L." The motors' ends were encased in asbestos and sheet iron, and the question of improved car wiring had also been dealt with, from the conduit standpoint. Mr. Green took a decided objection to asbestos, which he claimed only nursed and retained the heat from the adjoining sheet iron, until it caused fire. That was his experience, and he believed a good air space to be better. Mr. Farmer told how there had been trouble on their plow car cables until he cased them in lead pipe, with similar taps; and for four years they had been free of any serious trouble at all. Mr. Wright, of Providence, stated that on account of the breaking of solid wires to heaters, etc., they had put in stranded wire, with very beneficial results. In the treatment of cables, they brought out all taps above the floors, and used porcelain or clay tubing for the points of passage, as well as porcelain knobs, instead of cleating. His aim had been to get rid of rubber insulation around the connecting points, stripping the insulation well back and often using asbestos sleeves instead. The rubber insulation was often dangerous in carrying fire. He had recently been over the subject of car wiring with one of the representatives of the New England Insurance Exchange, and had found in that quarter a decided inclination to insist on metal conduit work for all car wiring, virtually making it uniform with house wiring in material and methods.

Mr. W. Pestell, of Worcester, made further inquiries of members as to car cables, and a variety of data and details were given, showing a marked tendency to improvement in this important item, as well as in regard to the leads to motors, etc. Mr. Ballard, of Boston, discussing the subject of rubber insulation again, stated that they had got some splendid results with okonite and Washburn & Moen rubber leads, which it had been impossible to set on fire, even by applying a torch to the rubber; and they used this on all leads to motors, resistance boxes, etc. The discussion then branched out and was continued to such a length that at last the members had to adjourn reluctantly for lunch.

At the afternoon meeting a paper on "Improvements in Street Car Motors" was read by Mr. E. W. Olds, superintendent of Rolling Stock of the Milwaukee Electric Railway & Light Company.

Mr. Olds pointed out in what respects the present street car motors admit of improvement. One of these is greater accessibility for repairs. Nearly all motors as now designed are arranged to open at the bottom, while in repairing double-truck equipments it has been found more satisfactory to lift the car body from the truck, thus making it possible to do all of the repair work from the top. Gears should be made with wider faces than at present and the quality of steel should be better. The life of the present gears is from 18 to 24 months and the pinions from 12 to 18 months; Mr. Olds considers that these figures should be increased 100 per cent. The gear case should be so constructed as to stand abuse better, and the improvement might consist in casting the case as a part of the lower half of the motor frame, thus doing away with bolts and giving the gears absolute protection. Armature bearings should be made longer and larger, with linings that may be easily removed and either rebabbitted or renewed. The bearings should be designed to use only oil, to be fed through wool waste or wicks placed in wells below the bearings. The average life of bearing linings in Milwaukee is at present about six months, which he considers should be increased to not less than one year.

Mr. Olds considers that the contact between commutators and carbon brushes should certainly be improved, which can be done by making the commutator bars longer and deeper, thus giving better contact for the brushes and longer life. The present carbon brushes are not always reliable, and a better connection should be made between the carbon brushes and the brush holders. A weak point of present motors is the insulation of the magnet wire used for fields and armature coils, and he considers that some covering should be devised that will not carbonize. The article concludes with details of motors designed by the Milwaukee Electric Railway & Light Company, which embody some of the special features above suggested.

This admirable paper was discussed by Messrs. Mundy, Baker, Farmer, Green, Libby, Annable, of Grand Rapids, and others, and covered various topics. There was a general survey of details of motor construction, insulation, fields, etc., and a good deal of attention was paid to the pressing on and off of car wheels and gears. Particular attention was also paid to Mr. Olds' remarks on the question of gears, and the relative advantages of solid gears over split gears. The drift seemed to be altogether in the direction of the use of solid gears.

An elaborate paper by Mr. H. H. Adams, superintendent of shops of the United Railways & Electric Company, of Baltimore, Md., was then read in the regretted absence of the author, on the subject of "Shop Kinks." The illustrations of methods and processes that accompanied the paper were on exhibition in the convention room.

Mr. Adams described various conveniences that have been devised for use in the repair shops of his company. Among these is a compressed air sand blast, which is used for frosting glass and for making illuminated signs. Another is a device for cutting dashers for headlights, by means of which a dasher of No. 12 soft steel can be cut for a 10-in. head light in about eight minutes. An arrangement is described for unloading cars from railroad flats.

With this, the cost of which does not exceed $100, the average time in unloading 110 open cars on trucks with a gang of six men was ten minutes. Other conveniences are an armature cart and a trolley pole straightener. A method is described for reinsulating fields, full details of the various operations being given. It is stated that in nine months 281 fields have been successfully reinsulated by this method with No. 1 wire, no trouble having been experienced with any. An induction test for armature short-circuits is described. An old Baxter motor field is suspended and supplied with alternating current. The armature to be tested is placed in the magnetic circuit of this field and revolved slowly. A light piece of sheet metal is held at the top of the armature, and if there are any short-circuits they will be easily determined by the vibration of the tell-tale piece, which can readily be felt by the hand. Two devices are described for use in making armature coils.

A point that was discussed, following the Adams paper, was the reinsulating of machines or wire, especially fields. Mr. Green, of Rochester, stated that they had been reinsulating wire for seven years. The boy who ran the machine for doing it got $1.38 a day of nine hours; and every field was wound under a job order. Some members stated that reinsulation of all types of motor fields had not been found feasible. Mr. Mundy, of St. Louis, said that with six men they got eight fields per day on the basis on which they worked. He approved of the method recommended by Mr. Adams of testing by transformer, as the least carelessness of the coil makers or armature winders was detected at once, and saved the expense of putting an imperfect motor together. Mr. Ballard, of the Boston Elevated, said that they tested newly wound armatures up to 2,000 volts, and on old work they ran up to 800 or 1,000. Mr. Mundy said he used a frequency of 25 cycles, which gave him every test they wanted. In regard to winding coils for heaters, Mr. Ballard said that in repairing heaters it was necessary to wind long coils of wire, and in place of winding them on a mandrel, the wire is fed through a fine hole into the interior of a die containing several screw threads, which is revolved in a lathe; and the coil of wire is fed out as long as desired. Another neat little "kink" was mentioned by Mr. Lindall, of Boston, in regard to moving motor trucks. They had a large lift which takes the trucks from underneath the car on the upper floor, and takes them to the machine shops. They had to move the trucks from the lift or elevator 25 or 30 ft., and at one time had ropes and tackle and hauled the trucks around, until one day one of the men suggested that the trucks might be made to move themselves. So they took one of the car rheostats, put it on the wall, connected a feed line to it, and ran out a flexible lead to the truck, starting the connections. The truck then simply walked off by itself, as it were, and a great deal was saved in the way of pushing and hauling. Mr. Pestell also mentioned a neat scheme of regrinding engineers' air brake valves. He used a little motor with a fine wheel on it, mounted on the post of a lathe. The valve seat was then put in the lathe and revolved, and this motor attachment was run right across its face, finishing it up in two or three minutes. They had a hardened steel head for grinding the disc, and a small hole to take the stud on the face of the disc, putting in ground glass and oil between the two faces, facing off the disc in a very short time. This whole session was very interesting, as showing what a wealth of practical and useful information the members could draw upon in discussion.

At the opening of the Mechanical Association on Wednesday morning the paper of Mr. Alfred Green, master mechanic of the Rochester, N. Y., Railway Company, was read on "Car Shop Practice," accompanied by a number of sketches and photographs.

Mr. Alfred Green, Master Mechanic of the Rochester Railway Company, Rochester, N. Y., gave an account of the organization of the repair shops of his company, and described some of the conveniences with which it has been specially fitted. Among these are an air crane and pit with electric elevator, an armature holder for babbitting, a panel bender heated by gas, a band saw brazer, etc. The paper also describes in detail the latest type of car used in Rochester.

In the discussion, Mr. Mundy, of St. Louis, said he had installed a motor-driven mechanical hoist, which from the time the car entered the shop until it was in the air ready to let the truck run out, required only one minute. But with a four-motor car they had at least 16 leads to disconnect. These took a pretty good man at least two minutes or more than to hoist the car. He was therefore looking for a quick system of lead disconnection, but neither the General Electric Company nor the Westinghouse had been able to help him out. This opened up a discussion on connectors, which led again to one on the propriety of taking the trucks out and so getting an examination of them. As to inspection, it seemed to be the opinion that the mile basis was better than that of time. Mr. Lane said he gave cars a general overhauling and inspection after 20,000 miles, besides inspecting them underneath thoroughly every day or every other day. As to coil testing machines, it was stated by Mr. Baker, of Boston, that they had ten or twelve of them, and they had had no trouble in educating men to use them. After further discussion o methods and times of inspection, the conversation turned on the adoption of motor-driven machinery and tools in the car shops, and Mr. Pestell reported that they had subdivided to some extent in using separate motors for different departments, and he believed that while this was an advantage it was not policy to make individual drive for different tools, except large ones. The general practice appeared to be dividing machinery up in groups and driving with separate shafts with motors. It depended somewhat upon whether it was wood-working or iron-working machinery.

A paper was then read by Mr. W. O. Mundy, master mechanic of the St. Louis Transit system, on the "Type M Control," which dealt at some length with the details and operation of the Type M system of control of the General Electric Company. It is stated that while this system is of necessity more complicated than an ordinary series-parallel controller, it has advantages that give it a field aside from train use. For example, as nearly all of the weight can be placed under the car body, the platforms have much less to carry and more room is made for passengers; moreover, the motorman has a much smaller handle to operate and as there is so much less work to do he should do it more carefully. The ease of handling has caused a number of electric locomotives to be equipped with this apparatus.

This interesting paper was followed by a discussion as to results with the controller by those who had used it, and as to the point at which a system should stop at the series parallel or go on and adopt the new train control. The question also came in of the greater cost. Mr. Olds spoke of its satisfactory use on 25 of the single interurban Milwaukee cars, where it had been very satisfactory, and Mr. Beeler, of the Denver Tramway, mentioned its use on one or two of their freight cars with coal trailers. Mr. Mundy remarked that he did not intend to depreciate the drum controller in his paper, and it was best for some service; but there were some conditions under which the train control of cars must be more satisfactory than that of the smaller controller. The meeting then adjourned to examine the exhibits in the afternoon, leaving one paper for later consideration.

The twenty-second annual convention of the American Street Railway Association began on Wednesday at 2 P. M. in the Grand Union ballroom. In the absence of President Hutchins, of Detroit, in Europe, Mr. W. Caryl Ely, of Buffalo, first vice-president, called the convention to order and presented State Senator Edgar T. Brackett, of Saratoga Springs, who welcomed the body on behalf of the municipality. After this a letter of regret was read from President Hutchins stating that to his regret ill health would detain him in Europe until the middle of September. Mr. Ely then made the annual address.

After quoting from the recent Census Office report on electric railway statistics, President Ely said that the stupendous figures represent the investments of many thousands of people and relate to the intimate concerns and the daily life of millions of people. They are, therefore, the legitimate subject alike of popular and governmental interest and inquiry, and correct data and information concerning them are matters of the very highest importance. He was pleased to be able to state that the methods of keeping the records and accounts of this class of transportation companies are improving from year to year, and that it is rare to find an instance where the fullest and freest information is withheld from even the most casual inquiry. Service of great value has been rendered in this department of street railroad work by the Street Railway Accountants' Association of America. The classification of construction accounts and operating expense accounts which has finally been settled upon by this association was adopted by the United States Census Bureau in gathering statistics for its census of electric railways, and a representative of the Census Bureau has prepared a paper on the subject, which is to be read in the ac-

countants' convention now being held here. This classification has been officially adopted by the State Railroad Commissions of New York, Massachusetts, Connecticut and Maine, and is about to be adopted by the commission of the State of Pennsylvania. The association's form of monthly and annual report has also been approved and adopted by the National Association of Railroad Commissioners. The standard classification and forms of report have been approved by the leading bankers and financiers of the country. It is quite common at the present time for a banking firm examining properties with a view of purchasing to require the accounts to be changed in accordance with the forms of the Accountants' Association. It has already been adopted by many of the most progressive electric railways and by a larger number of companies than any other one system of accounting. Exact and precise uniformity in forms of classification and report are highly desirable, and the sooner it is attained, the better it will be for the stability and value of electric railway investments, and it would seem that the system which has been worked out by our Accountants' Association and adopted by such high governmental authorities, and which has received the approval of the financial and banking community, ought to be speedily adopted by all. The members of the Executive Committee join in urging upon members the desirability of immediate affiliation with the Accountants' Association, and the speedy adoption of its forms of classification and report.

The work of the various State Railroad Commissions has come to be of the highest value, not only in this regard, but in its bearing upon the actual operations of railroads in States where such commissions exist.

It is a singular fact that these, which at the beginning were so vigorously combated by railroad managers, almost without exception have come to be regarded as almost indispensable and of the highest benefit and advantage to the very corporations which are subject to their control and regulation.

Another striking development of the year has been the tendency displayed toward consolidation of the street railway properties in the smaller cities, together with the electric and gas lighting service; in fact, this tendency has been so marked during the last year that in spite of the large number of new street railway corporations that have been formed in the last 12 months the actual number of operating systems has been only slightly increased. The value of the properties, however, has been growing constantly and the general average increase in gross receipts for 1902 over 1901 was 9 per cent. The largest individual consolidation was that of the properties of the North Jersey Street Railway Companies and allied lines in the Public Service Corporation of New Jersey. Other notable consolidations were those at Augusta, Mobile, New Orleans, Kingston, Oakland and Norfolk and Newport News.

At the last annual meeting, it will be remembered, a very interesting paper was read upon the steam turbine. The investigation of this important subject has been continued during the last twelve months, and a further contribution is promised for this meeting, which it is hoped will embody the record of the advancement during the last year. Already plans have been prepared and actual work has been begun upon the installation of several large power stations in which this class of apparatus is to be installed. The most important of this character for street railway service thus far announced is that of the new station of the Union Traction Company of Philadelphia, where an installation of ten 5000 K. W. engines is contemplated.

A year ago considerable interest was awakened among street railway men, particularly those interested in interurban electric railroading, in the possibility of developing a single-phase motor for railway service. It was, of course, understood that such a motor would not be adaptable for city service, but many promises were held out to those who were interested in the development of long interurban lines. During the last twelve months assurances have been given that progress was being made, but up to the present time no reliable information has been available, and the electric railway engineers are still dependent upon the direct current motor for interurban as well as city work.

Mr. Ely supplemented this address with some further ones on association policy and on the status of the electric railway in the eyes of the community it served. He even suggested the possibility of a permanent place of meeting with a settled business-like method of defraying expenses, and no reliance upon the good nature and generosity of local companies for free entertainment.

Secretary Penington read the report of the secretary and treasurer, which showed that twenty companies had joined the association since the last meeting; that five members had withdrawn, mainly on account of consolidation; membership on August 24th was 206 companies. The financial transactions during the year were as follows: Balance in bank October 1, 1902, $9,948.03; receipts, $7,677.28; total, $17,625.31. Expenditures during the year $7,286.62, leaving a balance of $10,338.69.

Following the secretary's report the Chair announced the following gentlemen as the members of the committee on nominations to nominate officers and select a place for the next meeting: Messrs. Laffin, of Worcester; Goodrich, of Hartford; Sloan, of Chicago; Stanley, of Detroit; Henry, of St. Louis.

A discussion arose over the compensation paid or proposed by the Government for mail service, and after the proposal of the appointment of a committee of three to take up the subject, Mr. Grant was asked to formulate a resolution to that effect. The meeting then adjourned until Thursday morning.

The Street Railway Accountants' Association began its sessions on Wednesday also, the principal item of the proceedings being a paper on "Freight and Express Accounts," by Mr. Irwin Fullerton, general auditor of the Detroit United Railway.

On Wednesday evening a trip was given the delegates and exhibitors to the Saratoga Casino by the Hudson Valley Railway Company, where an entertainment was provided.

CONVENTION NOTES.

It has already been mentioned that the standard feature of every annual street railway convention—the exhibits—was this year characterized by an element of distinct novelty, and that in picturesque camp meeting style the various displays were grouped on and around the great lawn that occupies the court of the Grand Union Hotel.

The display made of machinery, trucks, tools, motors, etc., was quite large and fine. We describe below a number of the exhibits, and shall publish further data of the kind next week in regard to a number of important displays not now brought to notice, owing to the fact that the convention did not begin until Wednesday, when this issue of ELECTRICAL WORLD AND ENGINEER went to press.

MR. G. M. GEST, the conduit contractor and designer, of New York, was able to leave a good deal of the inquiries and new business in the hands of his Cincinnati representative, Mr. W. T. Jackson, who has already formed a wide acquaintance in the electrical field.

STANLEY ELECTRIC MANUFACTURING COMPANY occupied a large and handsome booth on the lawn, and rather took the convention by surprise with the exhibit of railway apparatus and material. There was shown a complete car truck for two motors, each of 48 hp, governed by the new and ingenious Stanley S. K. C. No. 2 car controller, in which a number of features of simplification and economy have been introduced. The controller was also open to full inspection, as well as a 35-hp motor, with the fields and armature exposed to inspection. There was also a new trolley base, with which the pole could be lowered almost to a perfect parallel plane with the car roof allowing very low arches and bridges or tunnels to be cleared. The exhibit was in charge of Messrs. S. T. Dodd, electrical engineer, and M. C. Canfield, F. W. Garrett, H. R. Wilson, G. Robb and W. R. Hamlin.

GENERAL ELECTRIC COMPANY had a handsomely decorated booth at the centre of the lawn, but did not attempt to make any display of apparatus, reserving its energies for the special excursion which it gave on Thursday, taking the train in the afternoon to its big works at Schenectady, and there providing lunch, as well as opening up all the departments for inspection, including that devoted to the Curtis steam turbine, now a theme of universal comment. At Saratoga the General Electric Company was represented, among others, by Messrs. J. R. Lovejoy, general manager, railway department; W. J. Clark, manager foreign department; J. G. Barry, assistant manager railway department; C. C. Peirce, Boston; J. J. Mahony, New York; E. H. Mullin, publicity department; F. H. Gale, Schenectady; T. P. Bailey, Chicago; F. T. Barbour, San Francisco; Geo. D. Rosenthal, St. Louis; J. C. Kalisch, Buffalo; W. B. Potter, chief engineer railway department.

STANDARD UNDERGROUND CABLE COMPANY had an attractive display of cable samples in parlor 238 at the Grand Union. Their staff was out in force, being represented by Messrs. C. J. Marsh and Kimball, of the New York office; T. E. Hughes, of Philadelphia;

J. E. Pietzcer, Chicago; S. E. Cosby, Boston, and T. J. McBride, of Pittsburg.

ELECTRIC RAILWAY EQUIPMENT COMPANY, of Chicago, represented by P. H. Harten, superintendent of factory, and Elmer P. Morris, as well as by Messrs. Knott and Morris, Jr., had a very fine exhibit of railway line material, motor starters, car rheostats, etc. The exhibit included a very interesting wire grooving machine, making about a 4-inch groove in the trolley service wire, for the clips. There were also shown a number of single and double trolley poles, as well as simple lighting poles as in use in Cincinnati and New York. The exhibit included some 50 different styles of overhead brackets, and a variety of other line material. The rheostats and motor starters were those of the Magneto Electric Company, of Amsterdam, and were remarkably compact for their capacity.

ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, of Boston, had a most interesting and effective booth display of their electric railway switches, including a group of antiquated historical line supplies that made one realize how far and how swiftly the art has traveled. Perhaps the feature was their new section insulator made in both galvanized malleable iron or strong bronze metal. The terminals that hold the trolley wire at either end may be detached from the central body and renewed without removing the body itself from the line. The renewable strip is lignum vitæ, with auxiliary terminals, and there are several other features making for endurance and efficiency as well as flexibility. Another exhibit was that of Aetna and Hecla line material, including the big dead end strain insulators used in Brooklyn; also third-rail supports, globe insulators, etc. On a large board were also mounted a number of quick break and heavy current switches, one of them taking up to 3,000 amperes. The exhibit was in charge of Messrs. J. R. Eckman, Boston; Ernst Waltman, New York, and Mr. Sanville, of Philadelphia.

ELECTRICAL WORLD AND ENGINEER was represented by Messrs. J. M. Wakeman, president; T. C. Martin, editor; J. R. Cravath, Chicago, and had booth space adjoining all the convention meeting rooms, from which copies of the journal were distributed during the meeting.

ROSSITER-MACGOVERN COMPANY had a large space on the lawn fitted up with a booth and replete with electrical apparatus, and occupied also one of the cottages in the annex, where a hospitable welcome was extended to all comers. A number of motors were shown, open for inspection, as well as armature and field coils, and commutators, including one of 750 kw., just finished for the Brooklyn Rapid Transit system. The exhibit was directed by Mr. McGovern, whose staff comprised Messrs. R. J. Randolph, J. A. Peirce, C. J. Macdonald, J. W. Archer and several other efficient men. A neat pamphlet of Rossiter-McGovern plants was distributed and was in great demand.

PITTSBURG REDUCTION COMPANY had a spacious double-barreled booth on the lawn, a conspicuous feature being a Waterbury Machine Company's wire drawing machine driven by a 10-hp General Electric motor drawing aluminum wire from ¼ to 3-32 inch, in seven passes, and in commercial practice from ⅜ to 3-32. A large variety of aluminum wire and bus-bar plate was shown, including samples of the wire, of which 1¼ million pounds have been sold to the Standard Electric Company, of California, and two million pounds to the allied Bay Counties Company; also samples of the wire for the New Milford Power Company; 200,000 pounds and 300,000 pounds for the Hamilton Cataract Company, thus giving a graphic idea of the extending use of this specialty. The company was represented by Messrs. A. V. Davis, general manager; A. K. Laurie, general sales agent; W. Hoopes, electrical engineer; S. K. Colby, New York; J. A. Rutherford and C. Harris, Cleveland; J. H. Finney, Washington; E. H. Noyes, Chicago; W. R. Darby, New York.

BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, had the largest electrical exhibit at the convention, in their booth, it being one of five rotaries for the Scioto Valley Railway Company's power plant at Columbus, Ohio. It is a handsome machine, receiving three-phase current and delivering 400 kw. direct current at 600 volts. It is six-pole, about 9 ft. high, and slightly over 10 ft. square at base. The order for these includes three 1,000-kw., three-phase generators, as well as step-up and step-down transformers. The exhibit was in charge of Messrs. R. T. Lozier, general sales agent; G. B. Foster, W. S. Arnold, A. E. Foote and C. Van Deventer.

ELECTRIC STORAGE BATTERY COMPANY made a comprehensive booth exhibit, the ample walls of which were lined with photographs o railway, lighting and isolated "chloride" plants. A very interesting map was shown, indicating by numerous rings every place in the United States where batteries had been installed—leaving out but two States, North Dakota and Idaho. There were also exhibits of two large railway cells complete; two cells of 2 F type in glass jars; and some exide cells. The exhibit was in charge of Messrs. C. Blizard, general sales manager; Albert Taylor, W. G. Gay, G. H. Atkin, F. J. Stone and W. R. Proudfoot.

BRYAN-MARSH COMPANY were represented by Mr. Guy V. Williams and Mr. J. P. Williams, who made no exhibit, but answered many inquiries in regard to Imperial lamps, inner globes, etc.

MR. F. W. DARLINGTON, consulting engineer of Philadelphia, was present in connection with his electric railway work as well as in behalf of the Darlington Electric Fountain Company's interests.

H. W. JOHNS-MANVILLE COMPANY, of Hartford, Conn., had what was considered the most artistic booth on the grounds, handsomely draped in red, with the Stars and Stripes caught up in an eagle's beak; a red canopy and massive columns made to resemble closely the famous Sachs "Noark" fuses. Of these fuses there was a complete exhibit up to 600 ampere capacity, the concern now making them up to 1,000 amperes on 220 and 500 volts. A most interesting display was also made of "Transite," their new insulating material for car work, adopted for the New York underground, and affording a most desirable protection for the motor circuits under the car. An exhibit was also made of the Johns electric car heaters, and of the electro-therm. There was also a display of car fuse boxes, underground boxes, high-potential strain insulators, etc., for trolley work, etc., standing a voltage up to 5,000. Among those present on behalf of the concern were Messrs. E. B. Hatch, president of the Johns Pratt Company; J. W. Perry, sales manager; J. Sachs, electrical engineer; J. E. Meek, J. Humphries and H. M. Voorhis.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY had an excellent space on the lawn, well decorated and also occupied one of the large private cottages at the side, where it showed a brilliant electrical sign surrounded by flags. A notable feature of the Westinghouse exhibit was the new system of multiple unit control, which has of late attracted so much attention. As is known, in this electro-pneumatic train control system, the actuating mechanism is not directly connected to the main source of current, but has a separate, independent battery supply, so that the controlling mechanism can be worked while the main current is cut off, so that it is possible to reverse the motors and use them to produce a braking effect when needed. The contact devices are actuated by pistons operated by compressed air working against spring pressure. The turret was shown in operation with a complete motor equipped truck for the Interborough Road of New York City. The cottage exhibit included car controllers and other apparatus and material. The company was represented by Messrs. A. Hartwell, L. M. Aspinwall, N. W. Storer, K. F. Elers, of Pittsburg; J. B. Ingersoll, E. W. T. Gray, D E. Drake, W. S. Rugg, C. Townley, J. L. Crouse, F. B. H. Paine, New York City; J. R. Gordon, Atlanta; T. P. Gaylord, E. Dryer, C. W. Regester, Chicago; R. S. Brown, D. E. Manson, M. H. Merrill, E. D. Mills, Boston; C. A. Bragg, Philadelphia; W. W. Lovell, Cleveland; P. T. Brady, G. W. Pulver and S. B. Storer, Syracuse, N. Y. There were also large contingents from the Westinghouse Traction Brake Company, and the Westinghouse Air Brake Company, while Mr. W. M. Probasco was the efficient representative of the publication bureau of all the Westinghouse companies.

THE SPEER CARBON COMPANY, of St. Marys, Pa., had a neat little exhibit in the hotel corridor, in charge of President Speer himself, including their well-known car motor carbon brushes, and other standard specialties.

"HABIRSHAW" wire and cable interests were well taken care of, Dr. W. M. Habirshaw, of the India Rubber & Gutta Percha Insulating Company, being present as well as Mr. J. B. Olsen, who has already made such an enviable record as the general sales manager.

"OKONITE" was adequately represented by Mr. George T. Manson, of the New York office.

NATIONAL CARBON COMPANY, of Cleveland, at the hands of Mr. N. C. Cotabish, sales manager, and Mr. R. K. Mickey, enjoyed good representation, its booth space being well filled with samples of all its well-known carbon specialties in the car line, as well as with its well-known Columbia dry cells for automobile purposes and ignition work in general. These gentlemen also had literature on the subject for distribution.

J. G. WHITE & CO., of New York, were represented by President J. G. White.

MR. C. O. MAILLOUX, the well-known consulting engineer, who has of late gone heavily into electric railway work and enterprise, was present, with his associate, Mr. W. C. Gotshall.

DEARBORN DRUG & CHEMICAL WORKS, of Chicago, had a space under the veranda which they employed as a reception room and for handing out ingenious souvenirs. They were represented by Messrs. R. F. Carr, vice-president and general manager; W. B. McVicker, second vice-president and Eastern manager, and Mr. G. W. Spear, of Chicago.

MR. C. J. HARRINGTON made himself thoroughly at home—and his friends—at Cottage E in the annex, and hung his signs bravely on the outer wall. With him were associated Messrs. J. E. Laughran, F. B. Jacobs and R. Taylor, and Mr. F. D. Masterson, for the Chase-Shawmut Company, of Boston

MR. FRED. LOCKE, of Victor, N. Y., associated with Archbold-Brady Co., of Syracuse, had a most striking and effective display of his celebrated high-tension porcelain insulators. A separate dark room had been fitted up, containing the high-potential transformer of Prof. Smith, of Worcester Polytechnic, as described recently in these columns. It is capable of giving a potential of 175,000 volts and with it over 100,000 was thrown on groups of porcelain and glass insulators to show how they could stand up under the enormous strain. Mr. Locke was himself present and was gratified at the astonished expressions from visitors in regard to the resisting powers of his porcelain insulators. A variety of the insulators were also shown in the Archbold-Brady space, as well as Locke glass insulators; and the space was at night beautifully lit up by several types of Nernst lamps, for which the Syracuse firm are agents.

OHIO BRASS COMPANY had displayed a great deal of taste and thought in fitting up its booth on the lawn, and had converted it into a very pretty floral bower, worthy of some carnival. At the same time the decorations served rather to set off than to conceal the admirable exhibit of trolley line specialties with which the company's name is so prominently connected. The company was represented by Messrs. C. K. King, secretary; G. A. Mead, chief engineer; N. M. Garland and J. C. Warren, Jr., New York; F. H. Jameson, Mansfield, O.; A. L. Wilkinsburg, general sales agent, and Burt Gellathy, Pittsburg.

GOLD CAR HEATING AND LIGHTING COMPANY had a large booth space in which were shown a variety of types of their well-known car heaters, etc., and as usual President Gold and General Manager Ward were present to meet hosts of friends and make new customers.

NATIONAL ELECTRIC COMPANY, of Milwaukee, had a most tasteful booth, with a Christensen motor-driven air compressor car outfit as an attractive feature. Under its new name the company is making an active and successful bid for street railway orders, and in its cottage annex showed photographs of the large generators which it is now building. At the cottage was also to be seen a small motor-driven model of an air compressor for cars. The company was represented by Messrs. F. C. Randall, general sales manager; J. H. Denton, J. T. Cunningham, J. F. Dixon, J. S. Hamlin, S. I. Wales and J. J. Nef, while the electrical department was specially represented by C. G. Burton, W. L. Waters, W. J. Richardson, C. D. Knight and J. E. Eldred.

BENJAMIN ELECTRIC MANUFACTURING COMPANY, of New York City, had a booth tastefully decorated with their specialties, which were shown by Mr. Basil G. Kodjbanoff, manager of the Eastern and export departments. This concern is making wireless clusters, which consist essentially of an insulating base of porcelain, two one-piece contact plates attached thereto. These serve as terminals to all the lamps in the cluster, and each is provided with a binding screw; and the other part is a removable casing of brass or aluminum supported by porcelain rings or bushings of special design. Obviously the cost of installation is very much reduced for ceiling and pendant lights, and the cluster is made thoroughly durable as well as compact and handsome. For series work the contact plates are made in sections so as to serve two adjacent lamps, the inner and outer plates, overlapping each other, thus giving series connection without wiring. In the exhibit were shown the styles adopted by the Interborough Company, of New York, for all cars, a series two-light cluster, as well as the five-light series clusters used by the New York Metropolitan in its car barns. Another example illustrated the application to window lighting where economy of space was an object.

A Marconi Interview.

The *Wall Street Journal* of Monday, August 31, prints an interview with Mr. William Marconi in which the inventor gives some information concerning his future plans and other matters. He says his experiments with wireless telegraphy have demonstrated that it is possible for him to establish commercial communication between America and Europe without employing the high towers used in his former demonstrations. He is not certain that he will be able to dispense with towers altogether, but can definitely promise that in less than three months the stations of his companies will be open for the reception of commercial business and that the height of the towers heretofore used may be materially reduced. He has determined certain facts with relation to wave lengths which will reduce the amount of power required for transatlantic communications nearly 50 per cent. His experience has taught him that all interference with wireless communications may be eliminated with the exception of malicious interference. That is to say, that it does not seem possible, in the light of present knowledge, by scientific means to prevent a malicious person from employing an amount of power not only unnecessary for legitimate purposes, but absolutely useless for the transaction of bona fide business, which will prevent the successful operation of an opposing wireless station. This is equally true of any system of telegraph. For instance, in the course of some of his experiments at Poldhu, the power employed was sufficient to disable the instruments in the postal telegraph station 18 miles away, so that they were useless for 24 hours. Upon learning this he abandoned all experiments upon this line in fear of an injunction and has not resumed them.

It is possible to permanently disable all telegraph systems by the same means. He could take a building next door to a telegraph office and, without any visible or tangible evidence, absolutely obstruct the operation of all lines leading from that office. Legal enactment will in time provide adequate protection for the operation of wireless telegraphy, just as it has provided penalties for the theft of electric currents. It is an open question now if present laws are not sufficient to prevent malicious interference. Marconi explained that by malicious interference he meant the use of high power discharges into the atmosphere, which were unnecessary to accomplish successful transmission of messages, and which, in fact, defeated the efforts of the person using them to accomplish successful transmission of intelligence. He thought that possibly laws would be enacted in time determining by legal limit the sphere of influence of wireless stations, thus guaranteeing them against successful attempts at wilful interference. He has determined positively that by the attunement principle it is possible for many wireless instruments to be operated and many messages dispatched simultaneously without becoming tangled in the least.

On the subject of the Berlin conference on wireless, Signor Marconi said one of the delegates is here with him, the Marquis Solari. The proceedings are to be made public on the 1st of September. Although he has a transcript of the transactions, he was not at liberty to speak in reference to the subject, but added that with Italy and England represented, the Marconi system has nothing to fear. He said there was no truth in the statement published that a consolidation of the Marconi and German interests was in contemplation. He had met the Kaiser in Rome, had discussed wireless with him, but there had been no consideration of the question of consolidation. The inventor will leave New York at once for Glace Bay, Cape Breton, for the purpose of installing his new inventions. He will return from there to South Wellfleet. He has placed a three months' limit on the interval before opening commercial communication with Europe, but those closest to him are confident it will be accomplished in less time. After his return to England he expects to so arrange his time as to visit America once a month in order to exercise a proper supervision over affairs on both sides.

Telephonic Nursemaid.

It is mentioned by a Western newspaper as an actual occurrence that a farmer's wife in the locality, wishing to visit a neighbor, pulled the baby's crib up in front of the telephone, opened the receiver, and told central if the baby began to cry to call her up at the neighbor's. This simplification of maternal duties may have an important bearing on the "race suicide" question.

CURRENT NEWS AND NOTES.

OHIO ELECTRIC LIGHT ASSOCIATION.—The ninth annual convention of the Ohio Electric Light Association will be held at the Hotel Chittenden, Columbus, Ohio, October 13, 14 and 15 next. This association ranks high as to the quality of the papers read at its meetings, the discussions thereon and the technical ability and enterprise of its members.

"INVENTOR OF THE COMPASS."—A little to the south of Vesuvius, on the Gulf of Salerno, lies the town of Amalfi, whose inhabitants have recently been celebrating the sixth centenary of Flavio Gioja, the inventor, so say the Amalfians, of the mariner's compass. They have found the man and fixed the date; it was Gioja, and about 1302 or 1303. There are people who doubt that there ever was such a person as Gioja, and many who incline to the opinion that the mariner's compass was doing good service many centuries before his date.

WIRELESS TELEGRAPH CONFERENCE.—Gen. A. W. Greely, Chief of the Signal Service of the United States Army, who has been in Berlin as one of the American representatives at the International Wireless Telegraph Conference, arrived last week from Europe. He would not talk of the work done by the conference in regard to an international code or otherwise, as it had been agreed that nothing would be given out pending the report of the various delegates to their respective Governments. "There were eight nations represented," said Gen. Greely, "and we were all treated with the greatest courtesy. I may mention that the first of the foreign delegations to call on the American representative was that from Spain."

TELEPHONE POLICE SIGNAL SYSTEM.—After a sharply contested competition extending over several years, the City of Cleveland has contracted for a police signal system employing the telephone instead of telegraphic apparatus. The system is that of the Municipal Signal Company, of Chicago, the apparatus being supplied by the International Telephone Company of the same city. The first installation was made in Chicago in 1899, and it has been in use in St. Paul for several years. The system was used at the Pan-American Exposition, and will be installed at the St. Louis Fair for police service. The action at Cleveland in connection with the recent adoption in New York of a telephone police service, points to a general change in the methods of police signaling service.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—The thirteenth annual convention of the American Electro-Therapeutic Association will be held at the Hotel Windsor, Atlantic City, N. J., September 22, 23 and 24. Among the papers to be read are the following: "Currents of High Frequency, Apparatus and Therapeutic Uses," by F. G. DuBose; "The Use of Electricity in the Treatment of Diseases of the Heart," by S. Cohn; "Electricity in the Treatment of Diseases of the Stomach," by H. H. Roberts; "A Plea for Electro-Therapeutics Proper," by W. J. Herdman. Many other papers of special interest to the members and the profession in general are down on the programme. Dr. Clarence E. Skinner, New Haven, Conn., is secretary of the Association.

TELEGRAPHS AND TELEPHONES.—From the Statistical Year Book of the German Empire, Mr. Simon W. Hanauer, United States Deputy Consul-General at Frankfort, quotes the following: "In 1900 Germany had 24,471 telegraph offices, with 36,000 instruments in operation; Great Britain, 11,512 offices and 38,000 instruments, and the United States, 22,954 offices and 81,000 instruments. The number of telegraphic dispatches transmitted in 1900 was: Great Britain, 92,000,000; United States, 63,000,000; France, 50,000,000; Germany, 46,000,000. In Germany there were 2,411 cities or towns having public municipal telephone systems, with 305,795 connections. France had 1,199 public telephone plants with 72,480 connections." The telegraph figures as to the United States are decidedly incomplete.

WORLD'S FAIR HISTORICAL EXHIBIT.—The Board of Directors of the American Institute of Electrical Engineers has appointed a committee to arrange an exhibit showing the evolution of the prominent elements which are the basis of electrical engineering. Any person possessing or knowing of the whereabouts of interesting historical electrical machines or appliances, will render the committee a great service by communicating with the chairman, or one of the members at once. The exhibit will be given a prominent place in the Electricity Building, where the Institute will also maintain headquarters. The members of the committee are: Mr. T. C. Martin, chairman, 114 Liberty Street, New York; Mr. W. J. Hammer, Havemeyer Building, New York; Mr. J. S. Anthony, 44 Broad Street, New York; Mr. Henry Noel Potter, 510 West Twenty-third Street, New York; Mr. Cloyd Marshall, Electrical Department, World's Fair, St. Louis, Mo.

EAST PITTSBURG TECHNICAL NIGHT SCHOOL.—A Technical Night School will be conducted in the Casino Buildings, East Pittsburg, Pa., by Mr. Henri F. Chadwick, formerly one of the faculty of Tufts College and of Armour Institute, the courses of which are particularly arranged for clerks, mechanics and apprentices employed in the various Westinghouse works. The school term will extend from September 1 to June 1. Three courses will be taught, namely, mechanical-electrical engineering, mechanical-steam engineering and shop practice, each extending over two years. There will also be special courses in mathematics and a preparatory course in this branch. The teaching will be supplemented by lectures by experts on engineering subjects. Instruction books will be supplied free to students, and a diploma granted at the end of a course if all examinations have been passed satisfactorily. Five scholarships will be offered to those who obtain the highest rank in the courses. The fees are $3 for entrance and $2 monthly.

REPORT ON PARIS DISASTER.—The Paris Municipal Committee investigating the recent tunnel disaster on the Metropolitan Railroad, has drawn up a report, which has been approved by the Prefecture, indicating the reforms which should be immediately made in the underground railroad system of Paris. The principal proposals are that the present system of a motor at each end of the train should be suppressed; the motors must be capable of isolation from the train; in case of the slightest fire, the train must be stopped, and the motor isolated; telephones and speaking tubes must be provided at reasonable intervals along the line; the number of employees at the stations must be increased; the platforms must be cleared of every obstruction and lighted by an electric current, independent of the currents supplying the traction or the lighting of the tunnels; and numerous lamps must be placed to indicate the direction of the exit. The report says that it is proposed to insist later on the use of incombustible rolling stock, and the construction of refuges in the tunnel walls.

THE CONVENTION OF EDISON ILLUMINATING COMPANIES.—The Association of Edison Illuminating Companies will hold its next convention on September 8, 9 and 10, at the Frontenac, Thousand Island, St. Lawrence River, N. Y. Following is a list of the papers to be read at the convention: "Commercial Experience with Nernst and Meridian Lamps, by Mr. W. B. Thompson, Detroit, Mich.; "Purchased Electric Power in Factories," by Mr. E. W. Lloyd, Chicago, Ill.; "Operating Features of High Tension Power Stations," by Mr. W. F. Wells, New York, N. Y.; "Position of Steam Turbines in Central Station Operation," by Mr. August Kreusi, Schenectady, N. Y.; "Overhead Pole Line Construction and Operation," by Messrs. A. H. Manwaring and J. T. Hutchings, Philadelphia, Pa.; "Comparison of European and American Engineering Practice," by Mr. Charles Schwartz, Chicago, Ill.; "Profitable Advertising," by Mr. W. H. Johnson, Philadelphia, Pa.; "The Central Station and the Isolated Plant," by Mr. Douglass Burnett, New York, N. Y.; "Depreciation in Electric Light Plants: How Estimated and Applied," by Mr. H. M. Edwards, New York, N. Y.; "Selection and Installation of High-Tension Switching Apparatus," by Mr. Leonard L. Elden, Boston, Mass.; "Illumination," by Mr. C. P. Steinmetz, Schenectady, N. Y.; "Results Obtained with Steam Turbines in Milan, Italy," by Mr. Guido Semenza, Milan, Italy; "The Development of Summer Lighting," by Mr. E. A. Leslie, Brooklyn, N. Y.; "Notes on Commercial Features of European Lighting Practice," by Mr. Arthur Williams, New York, N. Y.

HELIUM FROM RADIUM.—Sir William Ramsey recently made the announcement that some experiments appeared to show that there is a production of helium—a rare constituent of the atmosphere—continuously from radium.

WIRELESS MIXED METAPHORS.—The wireless telegraph station which has been established at the Brooklyn Navy Yard was placed in working order last week, and it immediately got into communication with trolley cars in various parts of Brooklyn every time the cars "lost their trolley." Signals from the station at the yard and from the DeForest wireless station at Coney Island got to crossing each other, and as neither had the slightest idea what the other was talking about the Navy Yard got about as much wireless news from Coney Island as Coney Island got got from the Navy Yard. Attempts were made by the operators at the station at the yard to get into communication with one of the warships in the waters near the eastern end of Long Island, but these were unsuccessful. The Slaby-Arco system is used at the Navy Yard, with a flag pole antenna 180 feet high.

ELECTRICITY IN SPAIN.—According to the Boletin de la Cámera Oficial de Comercio de Cadiz, the following statistics show the number of gas works and electric plants in Spain and the amount of taxes collected thereon in the year 1901, the latest year for which statistics have been published: During the year 1901 there were 79 gas works in operation in Spain. The production of gas was 136,853,231 cubic meters, which yielded a tax of 2,048,342 pesetas ($395,330). The electrical plants in operation numbered 961, of which 266 were in the province of Barcelona. The provinces of Huelva and Orense had but two each. The annual production in kilowatt-hours reached the figure of 42,248,657, which yielded a tax of 1,955,302 pesetas ($377,383). Taxes from the manufacture of calcium, 27,834 pesetas ($5,372); customs duties collected on imported calcium, 154 pesetas ($30); taxes from the Basque provinces, 105,180 pesetas ($20,300). Total taxes collected on gas, electricity and calcium, 4,136,812 pesetas ($798,404).

THE GEM KUNZITE.—A new and unusually phosphorescent gem has been discovered by Dr. George F. Kunz, President of the New York Mineralogical Club and a gem expert, after whom it has been named by authorities. Near Pala, California, crystals of the new gem as large as a man's hand were found. The tint is described by Dr. Kunz as "rosy lilac." When cut and mounted in a certain way one of these crystals yields a gem of unusual beauty. The discovery is of more than ordinary interest because nothing similar to the new gem has ever been seen by gem experts or jewelers before. In the course of the tests by Dr. Charles Baskerville the Kunzite crystals were subjected to the action of ultra-violet light without showing any evidence of fluorescence or phosphorescence, and is was not until it was subjected to the bombardment of X-rays of very high penertation that it became at all fluorescent. On its removal to a dark chamber it exhibited a persistent white luminosity never before observed in its class of minerals.

RADIUM AND THE CREATOR.—Mr. Julian Hawthorne has the following in a recent article in the *Booklovers' Magazine* "And, if radium does undermine the time-honored theory of the conservation of energy, it is an intimation of things which are precious to philosophy, if not to practical life. The conservation of energy shuts us up in a box, into which nothing new can enter, from which nothing can escape. Among other things which are thus shut out, or in, is the Creator Himself. But the Creator is infinite; how can He be enclosed or excluded? The destruction of the conservation of energy theory would discredit that other great creed of the last century—the alleged truth of evolution. Man would not have been evolved, through interminable continuous processes, from the protoplasmic cell; but each successive order in nature would be distinctly created, without continuity. There would be some—and that the characteristic—thing or principle in each step of the series which had not been in the series up to that time. And the Creator, consequently, would be relieved from the present charge of having set a machine going in the beginning which has been running ever since without His interference, leaving Him to amuse Himself otherwise or not at all, and He would be shown in a state of constant and infinite activity." What bosh the magazines admit!

LETTERS TO THE EDITORS.

The Metric System.

To the Editors of Electrical World and Engineer:

SIRS:—I have just noticed for the first time a statement in your issue of August 15 that the "press agent of the metric opposition" stated recently before the Furniture Association of America that "in France, the country in which the system originated, it is in practical disuse."

As I made an address on this subject before this association at its recent meeting, I conclude that your courteous words refer to me. Inasmuch as I made no such statement, nor anything comparable with it, I trust you will allow me to correct the mistake under which you labor.

By the way, why do you ignore the statement made in Mr. Colle's recent letter that electrical units are not metric? Outside the ranks of pure scientists, the chief support for the metric system is found among electrical engineers, and the "metric" character of their units is the stock in trade of their arguments. Do you not know that you cannot afford to ignore the challenge of Mr. Colles?

NEW YORK. F. A. HALSEY.

[We regret that in quoting verbatim a newspaper statement we unwittingly did an injustice to Mr. Halsey. The statement that electrical units are not metric was not ignored, though we confess it was disposed of rather summarily; to discuss seriously such a statement in the columns of an electrical journal would imply a very poor opinion of the intelligence of its readers.—EDS.]

To the Editors of Electrical World and Engineer:

Sirs.—The communication of Mr. J. G. Vogel in your issue of August 15, relative to the metric system, would have remained unanswered, as it contains absolutely nothing new, nothing which has not been said a hundred times, and answered as many, and the citation from Arthur Schopenhauer, which I made in my former communication, has remained and will ever remain as true as the day it was written; but one remark of Mr. Vogel's is, to say the least, interesting.

The funny part of it all is, that the try-it-on-the-dog proposition—meaning a Government dose of metric system—is now fathered upon me, and I am pronounced "hard-hearted" for such a cruel idea. Alas! much as I would like to have originated so fitting a phrase, I dare not appropriate thus publicly the words of the enemy. Permit me, then, sir, to inform you that this is no *bon-mot* of mine, but the very words of the Hon. J. H. Southard, chairman of the Committee on Coinage, Weights and Measures, of the House of Representatives, and of his spontaneous utterance, in his explanation or extenuation of his own measure, given on the floor of the Convention Hall of the American Society of Mechanical Engineers at their annual meeting last December! Mr. Southard's idea of this bill, in other words, was not at all a part of a well-defined and decided course which was to cause the general use of the metric system—that, in the face of the wall of evidence with which he was confronted, he could not maintain—but a mere trivial tinkering, like the child's "poke it and see what it'll do" before some strange insect. Sir, I most thoroughly agree with you as to the hard-heartedness of this proposition; will you not, then, unite with me in opposing it?

And permit me to say further that if there appears to be animus on our side, it is not directed against the metric system *per se*, which, to be sure, many of us disapprove, but is the reflection of a just indignation against the insinuating and semi-subterranean schemes by which it has been promoted, and which are more reminiscent of the machinations of certain religious societies to get possession of governments in the eighteenth century than of *progress* in the twentieth; the cult having charge of this propaganda, whose headquarters appear to be a body calling itself the American Metrological Society, having no less a means in view, to accomplish their end, than *the taking away of our constitutional liberties and the substitution of the autocratic methods of Europe.* Yes, gentlemen, that is the plan. Now let those who think they want metric system at that point of the bayonet sit down and medicate a while on these things and then tell me if they still think the game worth the candle.

And now, Messieurs the Editors, may I suggest, in my most dul-

cet tones, the propriety and even desirability of such of your readers as may have an opinion to express, or suggestions to make, on this rather vexed question—making a little investigation into "th state of the art" first—just to avoid some unnecessary repetition and insure some advance in the discussion; and perhaps I may even go so far as to recommend the paper of Mr. F. A. Halsey, December, 1902 (published by the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York), as one containing a good many things worth knowing.

George W. Colles.

Montreal, Canada.

[The metric question in its present aspect is a practical one, which can be neither forwarded nor retarded by discussions of an academic or personal controversial nature. Setting aside the matter of the intrinsic merit of the metric and English systems, the fact remains that the latter is a handicap to our foreign trade, and to study and research in the great engineering and scientific literature of the Continent. Since there is no possibility that the countries now using the metric system will ever discard it for the English system, the practical question is whether as a great commercial nation and one which owes so much of its industrial prosperity to the teachings of science, we shall continue to suffer this handicap. It now seems to be a matter of but a few years when Great Britain, by pressure from her colonies and her commercial interests, will be led to adopt the metric system. We thus have the alternative of anticipating such action or later being constrained by the situation thereby created of supinely following the lead of our principal competitor in the markets of the world.—Eds.].

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Winding of Magnet Coils.—Zischeck.—A mathematical article, in which the author deduces a formula for the calculation of the depth of the winding of magnet coils with a given amperage and a given resistance of the wire, for square, round and elliptical cross-section of the magnet. Several examples are calculated. The formulas are long but simple. The author claims the following advantages for the formulas 1. They permit of seeing whether the space assumed for the winding is sufficient without requiring the dimensions of the wire to be known. 2. From the calculated depth of winding, the dimensions of the wire can be quickly and exactly determined in a simple manner, and the laborious trials are done away with. 3. The equations can be used for every form of cross-section of the magnets, if the necessary coefficients are calculated according to formulas given in the article.—*Zeit. f. Elek.*, August 9.

Transformer of 1,000 Kw.—An illustrated description of a recent Oerlikon construction of a transformer of the oil-insulated type with artificial cooling. The apparatus is built for 1,000 kw at 3,000 volts primary and 27,000 volts secondary potential at 50 cycles. It contains three iron cores, each of which carries a high and low-pressure winding, separated by an insulating layer of 10 mm. thickness. One high-pressure coil contains 35 coils, each consisting of 26 windings of bare copper strip of 1 × 13 mm. cross-section. The low-pressure winding has 18 coils, of 10 windings of copper band of 2.5 × 33 mm. cross-section. The high-potential coils are star-connected, the low-pressure coils in triangle. The current strength at normal load is 21.5 amp. in the high-potential and 110 amp. in the low-potential coils. Data as to the iron losses at 52 cycles, the fall of potential, the testing for overload, efficiency calculation, etc., are given in the article.—*Zeit. f. Elek.*, July 26.

References.

Universal Forming Machine for Armature Coils.—Robinson.—An illustrated description of a recently-designed machine for forming armature coils for different sizes of armatures. The mechanism and the mode of operation are described in detail.—*Am. Mach.*, August 20.

Lights and Lighting.

Reference.

Hot-Wire Enclosed Arc Lamp.—Tomlinson-Lee.—A short article with diagrammatic illustration of the Foster lamp, in which a thermo-expansive strip is used for the control of the striking and feeding mechanism. It is stated that very little more than the internal resistance of the lamp and mechanism, about 2 ohms, is needed on direct current. Its apparent indifference to circuit conditions is claimed as the most remarkable characteristic of this lamp. A pair of lamps adjusted to burn on a 220-volt, direct-current circuit was switched over to a 220-volt, 50-cycle, alternating-current, without the arc breaking.—Lond. *Elec. Rev.*, July 31.

Power.

The Storage Battery in Mining.—Huber.—A long, illustrated article. The author thinks that it is very surprising that up to now so few mines have installed storage battery plants, as the faculty of the storage battery to equalize the load on the power plant is particularly valuable in mining on account of the intermittent working of the machines. He attributes this state of affairs to the ignorance of the interested parties as to the advantages of a storage battery. After briefly noting these advantages, the author gives a description of a plant at a silver mine, with illustrations of some of the machinery and the storage battery plant. The latter consists of 275 elements, with a capacity of 370 amp.-hours, a maximal charging current of 226 amp., and a maximal discharge current of 370 amp. Three dynamos furnished current for the whole mining plant, being kept running day and night, and their current varied from one instant to the other between 10 and 100 amp., according to the demands made upon them for power. After the storage battery was installed, there were used only 2 of the 3 dynamos in the forenoon, 1 in the afternoon and none at night. Diagrams are given showing the distribution of the load before and after the installation of the storage battery plant. For the size of the battery to be installed for such purposes, the author offers the following considerations: 1. The battery must be capable of taking up all sudden rushes of current; that is, on sudden interruption of the consumption of current to take all of the current generated by the dynamos connected in parallel, and in the next instance, when the power-consuming machines begin to work again, to furnish the excess of power needed above that generated by the dynamos. 2. The battery must be capable in case of a break in the machinery or another disturbance in the generation of current, to furnish the whole power needed for a certain predetermined time; it has to have, therefore, of a certain capacity. If these two points are sufficiently considered, the following advantages accrue from the installation: *a.* The boiler and engine plant which has to be provided, becomes about 50 per cent. smaller and, therefore, cheaper; the saving thus effected will generally pay for the storage battery. *b.* The cost of production is considerably less, as not only the steam consumption is reduced to a minimum by suitably distributing the load on engines and boilers, but also the necessity of running them during the night is obviated. *c.* The safety of working is greater, for not only an overload on the machines is prevented, but in case of breakage or accident the power can be furnished by the battery. A detailed example is calculated for a hoisting engine at a coal mine, with a maximum effect of 621 hp. It is calculated that with electric drive and a buffer storage battery, only a 250-hp gas motor will be required to furnish all the power needed, which is now provided by a 621-hp steam engine. —*Glueckauf*, August 8.

Forty-Thousand-Volt Power Transmission.—Guarini.—A note on a 15,000-hp installation in the Alps between Italy and the Tyrol, to be built by the Oerlikon Company. The tension at the terminals of

the three-phase generators will be 9,000 volts, with a frequency of 42. The plant is said to be interesting as the first in Europe to make use of a tension of 40,000 volts as well as of transformers of a capacity exceeding 2,000 kw.—*Scien. Amer.*, August 8.

Gas Producers for Poor Gas.—DUPUY.—An illustrated description of the Pierson system, with tests showing a consumption of fuel of about 1,073 grams per kw-hour. The author concludes that the ease of running three gas producers, their low cost of maintenance and the possibility of using cheap coal in them, are such that a considerable development in this line may be foreseen in their application to small and medium motive power.—*L'Eclairage Elec.*, August 8.

Critical Speed of Steam Turbines.—ZURNEDDEN.—An article in which the author calls attention to the necessity for high speeds to secure economy in steam turbines, and points out that in these high speeds the centrifugal forces which enter are of a hitherto unknown magnitude. It is seldom, if ever, possible to bring the center of gravity of the rotating part to the center of the shaft with mathematical exactness even with the most careful balancing. The resulting centrifugal force tends to bend the shaft, and this bending increases with the speed and the eccentricity of the center of gravity. He shows that this condition does not become dangerous until a so-called critical speed is reached, and he deduces this speed in terms of the bending of the shaft. The methods of balancing the rotor are given.—*St. R'y Jour.*, August 15.

REFERENCES.

The Electric Motor for Small Industries.—LOEWIT.—A popular article reviewing the advantages of the motor for this purpose and giving some calculations of the cost of installation and power.—*Der Elektrotechniker*, July 31.

New Shirt Factory Driven by Electricity.—An illustrated description. Power is furnished by steam to a high-speed enclosed compound engine, coupled directly to a compound-wound multipolar dynamo for 220 volts at full load. Separate mains for lighting and power are run from the main switchboard to distributing boards on each floor.—Lond. *Elec. Rev.*, July 31.

The Diesel Engine.—ADE CLARK.—A paper read before the recent meeting of the English Institution of Mechanical Engineers. In the introduction the author describes the principles of construction and the development of the Diesel engine, after which he gives a description illustrated by cuts and diagrams, of an 80 brake-hp engine. The paper is especially valuable for the detailed account which it contains, of a number of tests made on Diesel engines of 35, 80 and 160-hp, and a table giving the total cost in power production for the Diesel engine, the gas engine and the high-speed compound condensing engine.—Lond. *Eng'ing*, July 31, August 7; abstracted in Lond. *Elec.*, August 7.

Liquid Fuel.—HUBBARD.—An article covering in a general way the subject of liquid fuel. The author enumerates the various advantages of oil as fuel, and describes different burners for the same. —*Amer. Elec.*, August.

Internal Separators for Steam Boilers.—STROHM.—An illustrated article describing several devices for drying the steam before it passes from the boiler and without reducing its temperature. It is claimed to be more economical than separating the same moisture outside the boiler and returning it by auxiliary apparatus.—*Amer. Elec.*, August.

TRACTION.

Electric Traction with Single-Phase Motors.—A description of a test made recently on a trolley line in Milan of a single-phase motor, constructed by Dr. G. Finzi, of Milan. The latter is one of the directors of the manufacturing firm of Brioschi, Finzi & Co. He took a direct-current motor of the enclosed marine type, with a completely laminated magnet circuit, with removable pole-pieces. This method of construction gives a magnetic circuit of the highest permeability and also enables the field coils to be wound on a standard former and then slipped on the poles. In order to adapt the motor to alternating currents, the only important changes made were, first, to insulate each stamping of the armature and field more carefully than usual; and, second, to make longitudinal slots across the pole faces, so as to minimize the transverse flux due to the armature reaction as completely as possible. There are no subsidiary windings on the commutator connecting bars; at most these differ from those of the direct-current machine only by being made of high-resistance material. It is stated that the sparking is practically eliminated by these arrangements, so that it never exceeds that usually observed at the commutators of traction motors. The Edison Company, of Milan, co-operated in having the motor tested on a practical scale by fixing it on a car where it replaced a 27-hp motor. The direct-current supply was cut off for several hours, and the traction system was fed from a special alternator at 570 volts and 18 cycles. The runs were continued for several nights, the car, which weighed 9 tons, covering over 200 km. The speed occasionally reached 30 miles an hour, while the starting on a gradient of 1 in 40 was accomplished as easily as with direct current. A diagram of the wattmeter record for one section is given in the article. The equipment for alternating currents does not require controlling resistances, which are replaced by a variable-ratio transformer, for starting the motor and regulating the speed. In the actual test there were 5 notches on the controller, adjusting the voltage on the motor between 80 and 160, the primary of the transformer being wound for 570 volts. The abolition of starting resistances with the single-phase motor is stated to get rid of one of the great causes of energy loss with continuous-current working. The more frequent the stops and starts, the more noticeable does this comparative saving become. In ordinary tramway traffic Dr. Finzi is said to have found from actual wattmeter observations that the single-phase system affords a reduction of over 25 per cent. in the energy required per car. There would be in addition a considerably increased efficiency due to the more numerous transformations necessary for the direct-current supply. The equipment for single-phase working is somewhat heavier, but inclusive of the motor, controller and variable-ratio transformer, it is not more than 10 per cent. in excess of the weight of the direct-current apparatus, which is negligible in comparison with the weight of the complete outfit and the car itself. The demonstration of the practicability of the alternating-series motor is said to have apparently been highly satisfactory. Details of the behavior of the motor, its net efficiency, power factor and rise in temperature, are not yet available.—Lond. *Elec.*, August 14.

Suspension Railroad Barmen-Elberfeld.—KOEPKE, GOERING AND VON BORRIES.—A long abstract of a report made on the operation of this railway, repeatedly noted in Digest, after a little more than two years of continuous running. The advantages of the monorail suspension system are set forth at length. The second part deals with the observations made during the operation of the line, as to easy running, security of operation, noise, etc. All the wheels of a train were originally made driving wheels by being geared to a common motor placed between the two wheels of a truck. There was a certain loss of power in this arrangement, however, and, therefore, only one wheel of each truck has been used as driving wheel. Under these conditions the consumption of current for 15.2 km. with 24 stops, at a speed of 30 km. per hour, the car weighing 14.6 tons, was 6.375 kw-hours per car km., and 28.8 watt-hours per ton-km. Under similar conditions on ordinary roads, 35 to 40 watt-hours per ton-km. are assumed; the suspension road, therefore, has given an economy of 18 to 28 per cent., despite numerous curves of 90 meters radius. In the future each wheel will have its motor, and a still larger economy is expected. The third part is devoted to a comparison of the Langen system of monorail suspension railroads with other monorail constructions, and to the advantages of a suspension road for high speeds.—*L'Eclairage Elec.*, August 8.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Switching Transmission Circuits.—ADAMS.—An article in which the author reviews the conditions leading to the construction of oil switches and discusses their advantages and general arrangement. He states that the safety and reliability of operation at voltages of 5,000 or more require that each element of the equipment be so isolated as well as insulated from every other element that the failure or even destruction of one element will not seriously endanger the others, and, therefore, the cables from each generator to its switch should be laid in a brick or concrete conduit, which contains no other cables. The brick or stone compartment for each phase should be so substantial that the contacts of that phase may arc to destruction without injury to the contacts of another phase. Feeders passing away from the bus-bars should also be laid in separate fire-proof conduits; the folly of grouping a large number of feeders transmitting great powers was shown by the accident at Niagara Falls last spring. The switchboard connections are then considered by the author.—*Elec. Rev.*, August 22.

REFERENCE.

Safety Devices.—A profusely-illustrated didactic article describing various electrical safety devices beginning with the simplest form of fuse. Enclosed fuses, fuse circuits, cut-outs, main line cut-outs, branch blocks and their connections, together with single and double-pole circuit-breakers, are dealt with.—*Amer. Elec.,* August.

WIRES, WIRING AND CONDUITS.

Alternating-Current Wiring.—POOLE.—An article with a number of tables on alternating-current wiring. The author gives various formulas for calculating the drop and size of wire for inductive and non-inductive loads. The tables are very complete, giving power factors, inductance factors, resistance of copper wires calculated from parallel wires, each 1,000 ft. long, reactance of copper wires, energy drop in per cent. for low-potential, single-phase, two-phase and three-phase circuits, and ratio of reactance to resistance, which applies to circuits having any number of phases, provided the wires are arranged symmetrically so as to balance the mutual inductance.—*Amer. Elec.,* August.

REFERENCE.

Conduit Construction.—An illustrated article giving a description of the building of a very extensive underground conduit system for the Cincinnati Gas & Electric Light Company. Two hundred miles of conduit were laid, in runs varying from 1 to 150 ducts. The operations are described in detail.—*Eng'ing News,* August 20.

ELECTRO-PHYSICS AND MAGNETISM.

Deflection of the Positive Rays in the Electromagnetic Field.—STARK.—The author endeavors to explain the fact, found by Wien, that positively-charged canal rays are deflected to different degrees by a transverse field, which may be electric or magnetic. A bundle of canal rays is spread out in the form of a band or spectrum. Three possible explanations have been suggested, the first being that the most strongly deflected rays had a smaller velocity. Wien, however, showed that the most strongly deflected rays already had the maximum velocity. The second explanation is based upon a difference in the masses of the particles, a variable number of neutral atoms having attached themselves to the positive ion. In that case maxima and minima should have appeared in the deflection band, which have not been observed. The third explanation accounts for the phenomenon by the hypothesis that the electric charge of the different rays is different. The assumption has then to be made that the negative electron possesses only a part of the charge of the ion. Then the molecules might get a different charge by taking a different number of electrons. In that case the mass of the negative electron would have to be taken as being proportionally smaller and the negative electron would have to be imagined as still much smaller than it had been regarded up to now. This assumption seems to be confirmed by a recent observation of Becquerel, that the positive rays of radium are deflected by the magnet when they are traveling through a space filled with a gas, and that this deflection is the smaller the farther they have to travel in the gas. This explanation, however, would strike at the root of the electron theory, as it conflicts with the idea of the constancy of the elementary quantity of electricity, as it appears from electric measurements and from the electromagnetic radiation theory, it having furthermore been shown that the charge of the negative electron is identical with that of the positive electrolytic hydrogen ion. The author then gives another explanation, assuming the charge of the negative electron to be constant and equal to 3.1×10 to the $^{-10}$th power E. S. units, and the charge of the positive electron equal to this or a simple mutiple of it. He assumes that neutral molecules or atoms under the same conditions can assume a ray-like character in the same way as positively and negatively-charged particles, if they possess a very great velocity and traverse a gas in a straight line for a certain distance, and in striking certain bodies bring them to luminiscence. These neutral molecular rays, formed by transformation from the positive ion rays either by impact or by neutralization through taking on a negative electron, do not suffer deflection in the electromagnetic field. They, however, continue the motion of the positive rays, from which they were generated, and travel in the direction of the tangent, which is drawn to the deflection curve at the point where the transformation takes place. As positive rays are thus transformed into neutral rays at all points of the deflection curve, and makes an impression on the sensitive photographic film, a continuous absorption band is produced. The author thinks that this explanation does not conflict with any experimental result obtained up to the present time.—*Phys. Zeit.,* August 1.

Fluorescence of Crystals Under the Röntgen Rays.—STRUTT.—An account of some experiments by the author to determine the question whether the Röntgen rays are polarized or not. Blondlot a few months ago concluded that they were, but it has since appeared that he was misled by the presence of a new kind of refrangible rays from the tube, which are capable of brightening a minute electric spark. The author, reasoning from the fact that fluorescent crystals of magnesium platinocyanide light up with a different color, according to whether the plane of polarization of the incident light is perpendicular or parallel to the optical axis, thought that there might be a possibility that some such difference might appear, when the crystal was fluorescing under the influence of the Röntgen rays. Röntgen rays from a focus tube were allowed to fall normally on the prism faces of large crystals of the above salt, but the fluorescence was not found to depend on the angle between the optical axis of the crystal and the cathode stream in the tube. The experiment, therefore, points against the polarization of the Röntgen rays. A number of other fluorescent crystals, including various platinocyanides, apophyllite, calcite, feldspar and scheelite, were tried, but they did not exhibit any difference of fluorescence, depending on which face was exposed to the rays, or on the orientation of the face. Experiments on calcium tungstate were also tried. Natural or artificial crystallized calcium tungstate is brightly fluorescent under the rays, but the amorphous precipitated calcium tungstate is scarcely at all so. The amorphous variety was subjected to a prolonged boiling with water, for four days, and it was found on comparing it with some unboiled material of the same lot, that it had become much more fluorescent under the influence of the rays than the unboiled portion, though less so than natural crystallized scheelite.—*Phil. Mag.,* August.

Energy of Cathode and Canal Rays.—LEININGER.—An investigation undertaken to determine the ratio of the quantities of electricity carried by the cathode and the canal rays to the generating-current strength. The apparatus used consisted of a tube, which carried a brass ring closely fitting the wall of the tube, and having soldered to it a wire mesh. The rays were caught on an aluminum disk, the distance of which could be varied. The experiments were carried out in rarefied air, pure hydrogen and oxygen. The results are plotted and given in tabular form. The determination of the ratio of the cathode and canal rays to the current strength by which they are generated, has shown "that the quantity of electricity of the rays is directly a part of the generating current." This percentage increases rapidly with increasing evacuation, and it must be concluded from its high value at very low pressures that at these pressures the current is nearly all used up for the production of cathode and canal rays. The values for cathode and canal rays appear a little different, but it may be stated with a high degree of probability that after fully considering absorption, etc., these values are equal, and that consequently the appearance of the cathode and canal rays is nothing else than a splitting up into positive and negative ions, which fly away from the electrodes in opposite direction and take their charges from the current. The difference in absorbability is probably connected with the different velocities and rises of the particles, which form the cathode and canal rays.—*Phys. Zeit.,* August 1.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrochemical Equivalent of Silver.—PELLAT AND LEDUC.—A paper presented before the French Academy of Sciences. The authors have made a redetermination of the electrochemical equivalent of silver, using a hemispherical silver disk with 300 sq. cm. surface as cathode. The electrolyte was a neutral silver nitrate solution, and the anode was composed of pure electrolytic silver, separated from the cathode by a muslin diaphragm. The experiments lasted two or three hours and the current was furnished by a battery of storage cells. The current was measured by an absolute electrodynamometer. Three experiments gave an average value of the electrochemical equivalent of silver as 0.011195. The authors think that the total error could not be greater than ½ thousandth. They, therefore, consider it certain that the amount of silver deposited by a coulomb is comprised between 1.119 and 1.120 mgs., confirming results obtained by Potier and Pellat, and Paterson and Guthe, as against lower values obtained by Richards, Collin and Heimrod.—*Comptes Rendues,* Tome 136, p. 1649; abstracted in *L'Eclairage Electrique,* August 8.

Electric Resistance Furnace.—FROELICH.—A short paper, read before the recent Congress of Chemistry in Berlin, describing in a general way the result of the author's investigations to find a material to be used for forming the walls of electric resistance furnaces. This material must have a high melting point, must be chemically indifferent and must have a high electric resistance. It must also permit being made in different shapes, so that the furnace walls can be built up of a number of units. He has found a series of chemical compounds, the names of which are not disclosed, which satisfy these conditions, and the electric resistance of which is mostly much higher than of carbon. Conducting plates are formed from these materials by means of the electric arc, which in connection with suitable electrodes, form the heating units, from which the resistance furnace is constructed. These heating bodies are decomposed little if at all by direct currents.—*Zeit. f. Elektrochem.*, August 6.

Electrometallurgy of Zinc.—SALGUES.—An abstract of a paper read before the Société des Ingenieurs Civils de France. The author describes a process for treating zinc ore in the electric furnace. Oxydized and sulphuretted zinc minerals, with a suitable addition of fluxing materials, are melted and brought to reaction either among themselves or with carbon, iron, etc. There results a slag practically free from zinc, which is tapped off, and metallic zinc, which is also tapped off or volatilizes, according to the conditions of working. With cold minerals, of 40 per cent. of zinc, in furnaces of 100 kw, the production is nearly 5 kgs. per kw-day.—*L'Industrie Elec.*, July 25.

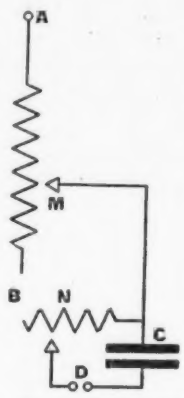
REFERENCE.

Electrolysis of Water.—An article describing the Garuti process for the industrial electrolysis of water. The process depends on the utilization of a perforated metallic diaphragm, which does not act as intermediary electrode as long as the voltage between the poles does not go above 3 volts. The apparatus is illustrated. An improved oxyhydrogen blowpipe is also described.—*Revue de l'Electricite*, July 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

On the Theory of the Quadrant Electrometer.—WALKER.—The author mathematically examines the theory of the symmetrical quadrant electrometer. Hopkinson pointed out that the usual formula given by Maxwell was imperfect, and gave an empirical formula which closely represented his experiments. The author found that Hopkinson's formula can be readily explained, as well as his general result, namely that the sensibility of the electrometer rises to a maximum as the potential of the needle is raised, and that any further increase in the potential of the needle reduces the sensibility. After a lengthy mathematical exposition he concludes that the investigation may be held to show that the air-gap as usually found in an electrometer is quite sufficient to account for the observed fact that there is a maximum sensibility depending on the potential of the needle. The conclusion is that the ordinary formula would be more nearly obeyed with a small air-gap. Diminishing the air-gap raises the potential of maximum sensibility, and the author also thinks it possible that higher sensibility will be attained thereby. With regard to Ayrton and Sumpner's results with the White electrometer bipolar suspension, the author explains the apparent conflict. They found a maximum at about 1,200 volts, but after falling a little the sensibility curve rises as the potential of the needle increases. They showed most satisfactorily that the effect is due to lack of symmetry, particularly of the guard tube. The author states that it is not, however, clear that this effect is the same as that obtained by Hopkinson. In his experiments the maximum occurred at about 800 volts, and thereafter the sensibility went on decreasing much more rapidly than in Ayrton and Sumpner's experiments. Hopkinson's instrument was also more sensitive. The author thinks that their experiments apply only to an extremely unsymmetrical instrument of comparatively low sensibility, and that the maximum considered in his paper is beyond the range of their instrument.—*Phil. Mag.*, August.

Resonance Coils.—MIZUNO.—The first part of an illustrated article. He describes some experiments which he carried out with an arrangement in which the two long parallel wires, used in Lecher's system, for the production of stationary electric waves, were replaced by two coils. He obtained much stronger effects, as the self-inductances of the wires are less than those of the coils and the capacities of the Leyden jars used must be reduced in order to get resonance, and, therefore, the electrical energy of the system becomes less. The author states that the well-known Tesla experiments can be easily performed by means of the coils, the method being much simpler than the Tesla apparatus, as it requires no separate primary or awkward oil insulation. The author then describes a way of producing the first odd harmonic of the fundamental vibration. He has also measured the variation of potential along the coil by means of a point-plate spark micrometer, the lengths of the sparks drawn being proportional to the maximum values of the potential at the corresponding parts of the coil. A curve is obtained by plotting the number of turns of the coil as abscissas and the spark lengths as ordinates; this shows that the potential which produces the spark does not vanish anywhere, that the vibration is not sinusoidal, and that the space-rate of variation of potential is rather slow in the neighborhood of the free end. By means of this method the author has also investigated the change of potential at the free end of the coil due to change in the length of the coil. The experiment was conducted with the arrangement shown in the adjoining figure. A coil, *A B*, was connected at *M* with a Leyden jar circuit. The self-inductance is adjusted by means of a movable contact, until the part, *A M*, of the coil is in resonance with the condenser circuit, *C D N*. The maximum spark length at the free end, *A*, was then observed. The contact piece, *M*, was then moved up and down the coil from the above position for resonance, so as to change the total length of the coil, and the corresponding maximum spark lengths were observed. The curve plotted from the values thus found shows that the rates of diminution of the spark lengths on both sides of the maximum point are somewhat unsymmetrical. Above the critical point the spark length decreases more rapidly than below the point.—Lond. *Elec.*, August 7.



RESONANCE COILS.

Measurement of Self-Induction Coefficients and Condensers.—BRION.—The author gives a method of comparisons based upon the use of an alternating current and a telephone. The apparatus is illustrated in the adjoining figure. *A B* is the measuring wire, *L n* and *L x* the known and the unknown self-induction, *C D* and *F G* two adjustable resistances, free from capacity and induction, *D F* an auxiliary measuring wire, and *T* the telephone. Two points are connected on the measuring wires; for instance, *P* and *E*, which will generally show a difference of potential. *P* is then moved, until a

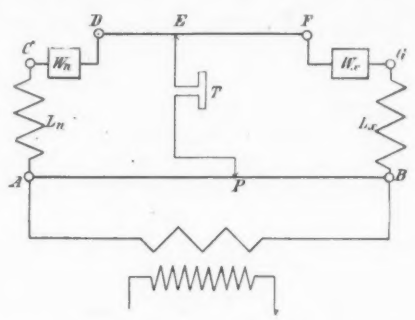


DIAGRAM OF CONNECTIONS FOR MEASUREMENTS.

minimum is reached, after which *E* is moved to the minimum; *P* is then moved again to a minimum and so on, until a simultaneous minimum is reached on both wires. A graphic solution of the problem is given by the author. The method is also applicable to condensers, as is shown by the author by a graphical solution for that case. If a condenser is to be compared by this method with a normal condenser, the dielectric hysteresis of which is assumed as being very small and the ohmic resistance as infinitely great, a resistance has to be connected in parallel to the normal condenser, which has to be so regulated that the sound disappears in the telephone.—*Elek. Zeit.*, August 1.

REFERENCE.

Power Measurement on Alternating-Current Circuits.—WILLIAMSON.—The author first discusses the power conditions met with in alternating circuits and then the power measurements on single, two and three-phase circuits.—*Elec. Rev.*, August 15, 22.

Telegraphy, Telephony and Signals.

Intercommunicating Telephone Systems.—O'Brien.—Another article in the series, the Couch & Seeley automatic intercommunicating telephone system, being described. In this system, as in the majority of systems for similar purposes, the automatic switch constitutes the distinctive feature. The switches are constructed so as to be mounted in the interior of the instrument, and they form an integral part of both the wall and desk sets. The switch consists of a number of strips of jacks mounted on a metal frame fastened to the interior of the instrument. Each jack strip contains five jacks, and in consequence the switches are readily constructed in any desired multiple of five. The lines from the various instruments are connected to the corresponding line terminals in the switch, the arrangement and number of terminals and the style of jack used depending upon the method of wiring. Sectional views of the switches are given, together with diagrams for connecting up the various stations.—*Amer. Elec.,* August.

References.

Telephone Engineering.—Dommerque.—An illustrated article dealing with the stringing of outdoor wires. The author describes adjustable reels, the different joints, splices, sleeve connections and methods of dead-ending and transposing with regular and pole transpositions. —*Amer. Elec.,* August.

Wireless Telegraphy Communication Between Martinique and Guadaloupe.—Guarini.—A popular illustrated article, giving a diagram of the electrical arrangement of one of the stations. The system used is the Ferrié, and it has been installed by the inventor.—*La Nature,* August 8.

Miscellaneous.

Electrification of the Brain.—Leduc.—A summary of the facts known concerning the action of electric currents upon the brain, with additional information concerning the electric production of sleep. According to Von Ziemssen, the brain substance is the best conductor in the human body, being about 3,000 times more conducting than muscle. That electricity has not been more frequently used in the treatment of brain disease is largely due to an exaggerated notion concerning the dangers involved. Generally speaking, a continuous current passing from one ear to the other produces dizziness, the objects appearing as if mounted on a wheel turning around, so that the top seems to pass from the anode to the cathode side. Currents from back to front appear to be innocuous and even beneficial. Thus a current brought up to 5 milliamp. in five minutes and kept at that strength for another five minutes, with electrodes on forehead and neck, increased the muscular power by 6 or 7 per cent., as measured on the ergograph. The best arrangement for the production of sleep is a current of 4 milliamp. at 30 volts, interrupted 100 times per second for nine-tenths of the period of interruption. The author has tried it on himself. The faculty of speech disappears first, then the motor faculties. Respiration and pulse are unaffected within the limits stated, but their temporary or final stoppage may be brought about by increasing the current. Short of that, awakening is instantaneous and the resulting feeling is one of refreshment.—*Arch. d'Elec. Med.,* July; abstracted in Lond. *Elec.,* August 7.

New Books.

Reflexions sur la Puissance Motrice du Feu et Sur les Machines propres a developper cette Puissance. By Sadi Carnot. Paris: A. Hermann. 116 pages.

This appears to be a photolithographic reproduction of the celebrated pamphlet that has made Sadi Carnot famous as the founder of the scientific theory of the heat-engine. The physical ideas presented are slightly different from those now in vogue, but the arithmetic and logic are as invincible to-day as they were when formulated by this remarkable scientist. The treatise is worked out in the metric system of units and the illustrations are substantially the same as those illustrating text-books on the theory of the simple heat-engines. It is interesting to observe that Carnot virtually took the absolute zero of temperature at — 267° C., instead of the modern assumed value of — 273° C. A dedicatory letter by Senator H. Carnot, the author's brother, written to the Academy of Sciences in 1878, and a sample page of the author's manuscript, end the little volume.

Infortuni Sul Lavori. Mezzi Tecnici per Prevenirli. Manuali Hoepli. By E. Magrini. Milan: Ulrico Hoepli. 215 pages, 258 illustrations. Price, 3 lire.

This little volume analyzes the various dangers to life and person presented by the operation of ordinary forms of machinery and trade processes. The various constructions and means for avoiding such accidents are also discussed. Only a few pages (225-232) in Chapter XI on "Electrical Machines," relate to electrical accidents. The ordinary rules of constructing machinery and switchboards to insure the safety of workmen and operatives are described. The treatment in case of severe accidental electric shock, is also outlined according to the suggestions of D'Arsonval. The book fills an important place in the literature of sociological mechanics and industry, but is not of much direct interest to electricians, or to those engaged in electrical industries.

Kalender für Elektrochemiker. Sowie Technische Chemiker und Physiker, 1903. By D. A. Neuberger. 583 pages. Beilage zum Kalender für Elektrochemiker sowie Technische Chemiker u. Physiker. 448 pages. Berlin: M. Krayn. Price, 4 marks.

This is an excellent electrochemical pocketbook drawn up with great care and covering a wide range of subjects. The first 82 pages contain a calendar with the regular saints days for the year. The next chapters relate to electrical measurements, with various useful table of constants and data. The second division contains 120 pages and relates to chemistry, and contains tables of constants such as atomic weights, solubility and analysis methods. The third division relates to electrochemistry and covers 300 pages. It contains a very large and useful collection of electrochemical data in tabular form clearly expressed. The Appendix has tables in mathematics, physics, heat, optics, mechanics, magnetics, machinery, fuels and various other matters of technical interest, including patent rules, and electric fire insurance rules. The Appendix is of thus greater importance to German than to American electrochemists.

Pratique des Essais des Machines Electriques. By Emile Duquesne and Ulysse Rouviere. Paris: Ch. Béranger. 362 pages, 223 illustrations. Price, 15 francs. 1903, price 15 francs, 362 pages.

The purpose of this useful book is to supply to the electrical engineer the outlines of test for any well-known type of dynamo-electric machine. The first chapter describes testing apparatus. Chapter II deals with laboratory tests. Chapter III treats of the methods of testing direct-current dynamos for the various properties usually regarded as significant. Chapter IV similarly treats tests of continuous-current motors. Chapter V describes the various tests of street railway motors. Chapter VI relates to the measurement of power transformation. Chapter VII deals with the testing of alternators. Chapter VIII, IX, X and XI deal with the testing of synchronous motors, converters, induction motors and transformers, respectively.

In an appendix are inserted the rules of testing and standardization adopted provisionally by the German Association of Electrical engineers at the Dresden Congress of June, 1901. The book will be very serviceable to electrical engineers.

La Traction Electrique. Tramways, Locomotives et Metropolitains Electriques. Par Paul Dupuy. Paris: C. Naud. 495 pages, 264 illustrations. Price, 12 francs.

This work discusses broadly the subject of electric traction, taking up roadbed construction, electric locomotives, street railway cars and traction in mines, and has also chapters devoted to electric traction of canal boats.

The first chapter, which introduces the subject, is devoted to general traction considerations both electrical and mechanical; the development of electric traction in different countries, both with reference to rail construction and storage battery work; and a classification of the different traction systems.

The second chapter is given to a theoretical study of the traction problem and particularly to that of different coefficients. The traction effort and the power necessary for traction is taken up and supplemented with formulas pertaining to these functions, and formulas are given for practical cases. The influence of curves and the formulas pertaining thereto are discussed, and the additional tractional effort due to grades is given some space, together with practical examples. A few paragraphs are devoted to the coefficients of traction and adhesion; the calculation of the traction effort and

the power in a general case for a known profile is given, together with the mean traction effort obtained over different lines of railway. This is followed by a calculation of the power necessary in central station for a line of known and possible traffic conditions, after which a part is devoted to the determination of the power of the motors for the cars and the necessary energy for planning grades and for acceleration, and the possible economies of power by a proper manipulation of the car is gone into at some length. The practical operative conditions on several lines of tramways supplement these discussions, and finally there is a list of the necessary information for a preliminary survey and the study of a proposed electric railway. This completes what is called the first part of the book.

The second part of the book is more of a descriptive nature and deals of central station material and rolling stock, and the characteristics and practical performance of machinery. The chapter on generators can hardly be called descriptive of the best modern practices, as much space is devoted to the description and performance of types, particularly belted machinery, which is now almost obsolete, at least in new railway installations. The following chapter is devoted to the discussion of various methods of construction for the permanent way. Here again considerable space is given to methods of construction which are rarely used in American practice, having had their period of trial and failure. Some interesting methods and tests on electrolytic phenomena are, however, of interest.

In the third chapter overhead construction is discussed and the work described and material illustrated is somewhat better, though hardly of the most modern character. Further on in the chapter electric railway conduit construction of various types is given consideration, and the chapter closes with a dissertation on sectional conductor systems. Chapter IV is devoted to rolling stock, and the machines illustrated contain, to say the least, a great number of "old-timers." The work includes numerous controller diagrams. The trucks given as examples are mostly of the four-wheel type, and the modern double truck is given but little space in the discussion. Following these are descriptions of various kinds of car bodies and overhead trolleys and means of heating cars, and then comes an interesting section on the application of alternating currents to electric railway construction. It discusses, in detail, however, only the systems of Ferraris and Arno.

Chapter V is a commercial chapter, dealing with the prices of materials, and while subject to the general criticism that must be made on all such compilations, it must not be forgotten that every contribution of this kind is of value even though it be seriously limited by conditions. The next chapter is the storage battery street railway work. It does not discuss the storage battery itself, but gives some practical examples of storage battery traction and systems of connection and manipulation.

The third part is devoted to financial considerations with reference to street railways, discussing gross earnings, possible cost of maintenance, cost per car kilometre, etc., and is supplemented with a large table of data on this subject and a list of French lines in course of construction. The following chapter is devoted to electric locomotives on roads at high speed and gives theoretical calculations and practical examples. It would hardly be a French work without a discussion of the Heilman locomotive, which is given considerable space. The fifth part of the work deals with traction machines for drawing canal boats and various traction applications in mines and systems of electric telpherage, the latter not covering the latest developments.

The appendix, although short, gives considerable data on subjects which are more modern, and materially improves the work. In conclusion, it may be said that the mathematical and theoretical part of the work is very good. The practical data, however, are not as modern as they might be, and the book is a better treatise of what has been done than a modern reference book.

JAHRBUCH DER ELEKTROCHEMIE. Berichte uber die Fortschritte des Jahres 1901. By Dr. W. Nernst and Dr. W. Borchers. Halle a.S.: Wilhelm Knapp. 725 pages, 226 illustrations. Price, 24 marks.

The present volume is the eighth annual issue of this well and favorably known publication. The former issues were edited by Professors. Nernst and Borchers, but the present one has for an editor Dr. H. Danneel, with the assistance of Askenasy, Borchers, Elbs, Harms, Von Kuegelgen and Mugdan. The volume, as in former years, is divided into two parts, the first dealing with scientific electrochemistry and the second with applied electrochemistry. The part on scientific chemistry covers 372 pages and gives the usual very complete review of the work done in the various branches during the period covered. The subjects represented are as follows: Apparatus and methods, theories, conductivity and condition of solutions, galvanic elements, polarization and electrolysis, electroanalysis, Becquerel rays and conductivity of gases, each subject with its various subdivisions. A review of the most important books which have appeared during 1901 is also included.

The part of the book on applied electrochemistry covers the ground in the same thorough and exhaustive manner as in former years. The advances and projects in the construction of galvanic elements and storage batteries are recorded. The chapter on metalloids and anorganic products includes among others hydrogen, oxygen, ozone, the haloids, graphite, carbon bisulphide, calcium and other carbides, silicides, etc., the work done in the production of alkali and bleach by electrolysis, etc. The section on electroplating has been cut short, for the reason that the periodical and patent literature on the subject has grown to be very voluminous. The electrolysis of organic compounds is treated fully and in a very able manner. As in former volumes, one section is devoted to electromagnetic ore dressing and separation. The last pages deal with electric furnace methods and diaphragms.

This series of volumes is a valuable addition to a library of electrical literature and will be found to be very useful as a digest of the literature, both to the engineer and to the student. The present volume seems to maintain the standard established by the previous ones. The reviewer, however, cannot help deprecating the tendency, always manifest even in the earlier volumes, but perhaps more pronounced in this volume, of passing adverse judgment upon books and investigations, which do not lay sufficient emphasis on or push into the foreground, the dissociation theory and other theoretical considerations promulgated by a certain group of German scientists. For instance, to say, as the writer of the review of the valuable "Lehrbuch der Anorganischen Chemie," by H. Erdmann, says, that "the book is totally unfit for the electrochemist, who cannot dispense with the dissociation theory and the law of mass action," is, in our opinion, going too far, and the judgment is certainly not shared by the German chemical public, as is shown by the rapid appearance of new editions of this work.

SCHEDULE FOR CONTINUOUS-CURRENT DYNAMO DESIGN. By Prof. S. P. Thompson. New York: Spon & Chamberlain.

This schedule, which is extracted from Prof. Thompson's book on dynamo design, consists of five sheets printed on heavy writing paper. The first sheet has blank spaces for the general description of a machine and a table for the commercial test entries. The next two sheets contain a blank tabulation for all the data of every element of a dynamo, and also a section for entries in tests for armature reaction. Sheet 4 is a schedule of calculations for the winding of field magnets; and on sheet 5 are a table for temperature tests and one for weights and cost.

BOOKS RECEIVED.

KURZES LEHRNBUCH DER ELECTROTECHNIK. By Adolf Thomalen. Berlin: Julius Springer. 515 pages, 277 illustrations. Price, 12 marks.

TELEGRAPHIC SIGNALS, VOCABULARIES, ETC. By James Nicholson. London: Whittaker & Company. 63 pages. Price, 5 shillings.

DAS ELEKTRISCHE KABEL. By Dr. C. Baur. Berlin: Julius Springer. 327 pages, 72 illustrations. Price, 8 marks.

DAS ELEKTRISCHE LIGHT. Und Die Elektrische Heizung. By Dr. Alfred Ritter v. Urbanitzky. Leipzig: A. Hartleben. 226 pages, 103 illustrations. Price, 4 marks.

DIE TELEGRAPHIE OHNE DRAHT. By Augusto Righi and Bernhard Dessau. Braunschweig: Friedrich Vieweg & Son. 478 pages, 258 illustrations. Price, 13 marks.

STUDENTS' GUIDE TO SUBMARINE CABLE TESTING. By H. K. C. Fisher and J. C. H. Darby. Third (enlarged) Edition. New York: D. Van Nostrand Company. 230 pages. Price, $2.50.

ELEKTRISCHER MASCHINER UND APPARATE. Von Dr. F. Niethammer. Berlin: R. Oldenbourg. 192 pages, 237 illustrations. Price, 8 marks.

CONTINUOUS-CURRENT DYNAMOS AND MOTORS AND THEIR CONTROL. By W. R. Kelsey, B. Sc. New York: D. Van Nostrand Company 440 pages, 225 illustrations. Price, $2.50.

MODERN STEAM BOILER: Its Practical Physics. By Frederick J. Rowan. With a preface by Prof. R. H. Thurston. 638 pages, 314 illustrations. Price, $7.50.

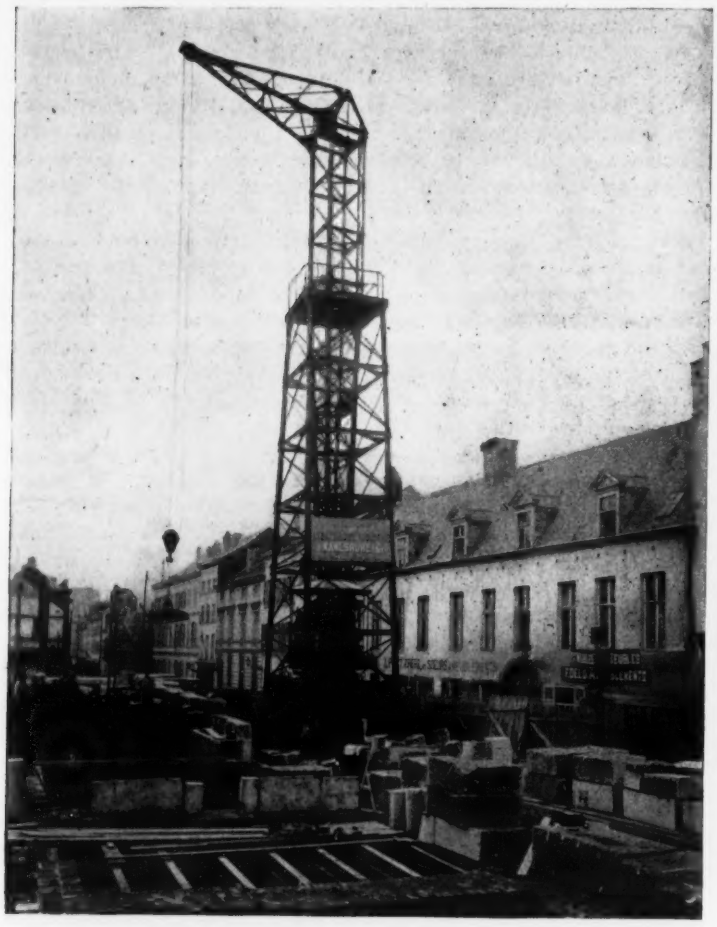
TOOLS AND MACHINES. By Charles Barnard. New York: Silver, Burdett & Company. 164 pages, illustrated. Price, $1.50.

THE METALLURGY OF ZINC AND CADMIUM. By Walter Renton Ingalls. New York: *The Engineering and Mining Journal*. 701 pages, 404 illustrations. Price, $6.00.

Electric Crane for Erecting Large Buildings.

BY C. BENDER.

A large armory under erection in a city in Belgium is being constructed with the aid of an interesting electrical hoisting crane. The crane, which is 80 ft. high, and provided with a movable jib of 20 ft. length, runs on a track of rails of 650 ft. long along the front of the building, the gauge being 11.5 ft. It is used for conveying the blocks of stone from the cars on which they arrive, to the place of the building where they are to be used. The crane rests on a car body with wheels so designed that blocks of stone may be stored between the rails without preventing the operation of the



ELECTRIC CRANE FOR ERECTING LARGE BUILDINGS.

crane. The crane is provided with three motors, one for raising and lowering the load, the second for moving the whole crane on the rails and the third for turning the crane.

A problem to be solved in the design of the crane was to assure its stability under the most trying conditions in spite of the relatively small gauge of the track; moreover the crane had to be designed to resist the greatest wind velocities, and able to run up and down a grade of three per cent. The speed of lifting with the maximum load of 10 tons is 10 ft. and the speed of traction on the rails 50 ft. All operations of the crane are governed by a universal controller. The entire weight of the crane is 110,000 pounds.

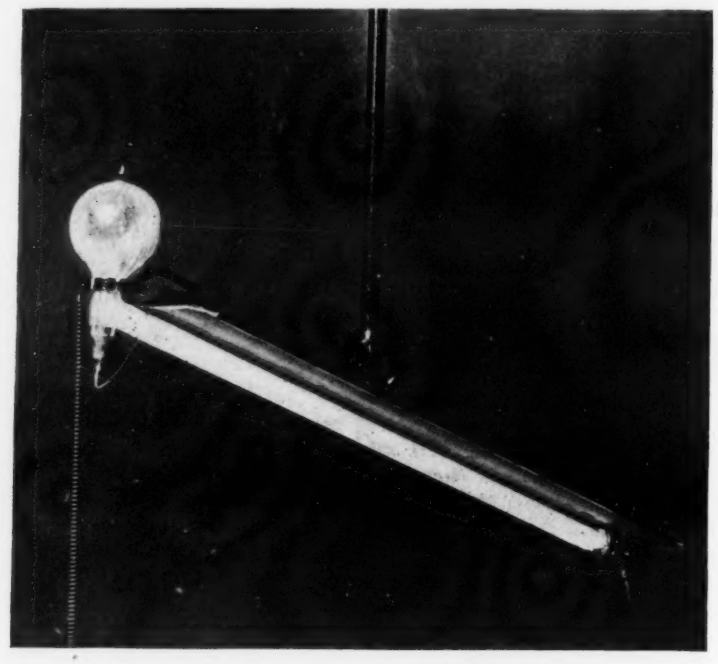
The crane is the first of its kind that has been constructed and it is expected that this type will soon find extended use in the erection of large buildings, and especially on docks. It is, without any doubt, one of the quickest and cheapest apparatus for such purposes. To appreciate this it is sufficient to estimate what scaffolding would cost for a building 650 ft. long and 80 ft. high, for it is evident that such a crane replaces not only the scaffolding, but includes at the same time the lifting apparatus. It will be found that it is cheaper and quicker than any other kind of provision for the same purpose. The experiments with this crane have given such excellent results that another crane of the same type, but 115 ft. high, is to be built for a similar purpose. The manufacturer is the Gesellschaft für Elektrische Industrie, Karlsruhe, Baden.

Improvement in Cooper Hewitt Vapor Lamp.

A notable improvement has recently been added to the Cooper Hewitt vapor lamp, consisting of a new method of starting. Up to now the lamps put into commercial use were started by a high-potential kick from an inductance coil. A special quick-break switch under oil was used to make and break a circuit across the coil, the discharge of which passed through the lamp, breaking down the initial reluctance to starting.

The new process of starting, which is due to Mr. S. E. Flichtner, one of the engineers of the Cooper Hewitt Electric Company, is known as the "Tilting" method, and is somewhat similar to that employed by Arons and other early investigators, in that an absolute connection is established between the two electrodes of the lamp by means of the fluid of the electrodes themselves. These former lamps had two mercury electrodes in the same plane and were started by being turned sideways, so that the two pools of mercury came into contact. On being returned to the original position the contact was broken and the conduction through the vapor established.

In the Hewitt lamp, however, the electrodes are placed one above the other and a connection is established by first tipping the lamp



NEW FORM OF VAPOR LAMP.

so that there is an excess of mercury in the normal upper electrode and then allowing this mercury to flow, by gravity, in a stream down the length of the tube. This stream momentarily establishes a metallic connection between the electrodes and then breaks, usually at the bottom, where it ends in a spray. The lamp lights across the break, the luminous area rapidly extending up the tube as the stream falls away. The liquid mercury has the property of stringing out into a long, fine, continuous stream, and lamps over four feet long have been lit in this manner, using no more mercury than is required for their normal operation. It is usual, however, to use lamps about two feet long to operate on 55 or 60 volts. This is the type of lamp illustrated in the cut.

At the upper end is the condensing and regulating chamber, which is one of the distinctive features of the Hewitt lamp. The lamp is supported by two asbestos-lined clamps to a metal tube, through

which run the wires to the two terminals. The rod is pivoted in the center and has a weight at the lower end, so that the lamp normally hangs as shown. A chain is provided for pulling the upper electrode down and thus furnishing it with a surplus of mercury. On releasing the chain the lamp returns automatically to its normal position, the stream is formed and the conduction through the vapor established. A spring and cushion at the pivot prevent any jar. An adjustable reflector is strapped to the supporting rod.

To operate on 110-120 volts, the lamps are connected two in series. If it is intended to light both lamps simultaneously they are mounted in one frame and tilted together. With an apparatus of this kind, a simple rheostat and choke coil for steadying resistance are all that is required. When the lamps are to be lighted independently, each is furnished with a resistance having in shunt across the vapor lamp another resistance which is automatically cut out when the lamp is started. Two 40-volt, 1.5-amp. incandescent lamps are used as the shunt, so that being first turned on by an ordinary switch the operation of tilting the vapor lamp may be readily accomplished in an otherwise dark place. They also serve as pilot lamps to show when the switch is left closed and the vapor lamps unlit.

Besides the lamp illustrated, the company is manufacturing two other types of "Tilting" lamps. Both are mounted in double holders and are intended to be lit simultaneously. One set consumes but 1.3 amp. and is intended for retouching lantern slide work, etc., while the others are the regular three-ampere lamps and are arranged for all sorts of photographic and printing work.

In spite of the falsification of colors produced by the light, the lamp is finding much favor as an illuminant for offices where close application is required. The company has recently installed vapor lamps for lighting the composing room of the *New York Evening Post* and the train dispatcher's office of the Pennsylvania Railroad, at Jersey City.

Use of Electric Commercial Automobiles.

SIGN FOR AUTOMOBILE CHARGING STATIONS.

In spite of whatever ideas may exist to the contrary, the use of electric commercial automobiles appears to have extended greatly during the past year; and the reports of firms employing them are on the whole very satisfactory. Under this head, ELECTRICAL WORLD AND ENGINEER has recently been in receipt of a number of interesting communications, which are presented in abstract below, and which have been sent to use directly by the parties concerned.

One of the most interesting letters to electrical readers perhaps is that of the Edison Electric Illuminating Company, of Boston. Mr. W. H. Atkins, general superintendent, writes us as follows:

We have only had a five-ton truck two weeks in our service, and we have not had time to go into the operating cost. We have ordered and will have in service within the next four weeks a five-ton truck, a three-ton truck, an emergency wagon for underground emergency work, and a trimmers' wagon for trimming arc lamps and two superintendent's service wagons. We propose to increase this number after a few months' trial of our present equipment. We feel that they will be a success and the truck we have now in use is showing good results.

I suppose you know that the Boston Edison Company is trying to promote the sale of electric vehicles by establishing charging plants on its lines throughout Greater Boston, and has published booklets showing various charging stations within a radius of 25 miles of the city. The company is also about to publish a new book of charging stations in New England.

We have instituted an enamel iron sign for these charging plants, which we hope will be universally adopted throughout New England, and will be known in time as well as the Bell Telephone Company's sign is to-day. I enclose you photographs giving an idea of the sign and a book of advance information giving an idea of the business we are trying to promote.

Mr. Lewis A. Platt, president and manager of the Platt Bros. & Co., Waterbury, Conn., writes: "(1) We have used one three-ton truck, electric, since last August, 1902. (2) It carries an average of 6,000 pounds 15 miles daily. (3) It is too early to determine with certainty the cost compared with other methods of transportation, but the indications are that under ordinary conditions the electric truck is the more expensive. (4) The electric truck is much more convenient than those drawn by horses in many ways. We have not fully decided whether this convenience is more than offset by the apparent increase in the cost of maintenance or not. With our present experience we should hesitate to purchase another machine for additional work, although we believe the defects would not be so apparent with a number of machines as with a single one, provided that they were built with interchangeable parts."

The Germania Roofing Company, of New York City, have had an encouraging experience, and say: "We have one automobile truck in use since June, 1902, and one automobile truck in use since January, 1903. The former will carry 4 tons 25 miles on one charge and very often covers a radius of 30 or more miles in one day, while the latter will carry 2 tons a radius of 40 miles, and has made several trips to East Mt. Vernon from our works on one ordinary charge and in less than 5 hours. The cost of maintenance seems to be that of renewing rear tires, pinions and batteries. In general we believe that $400 per annum would keep each vehicle in first-class condition almost indefinitely, and charging, storage and general care about $500 per annum, total $1,100 maintenance, charging, storing, insurance and interest on the investment would cover everything in our opinion except the wages of the operator. It is our intention eventually to use electric vehicles in the place of horses altogether."

Cluett, Peabody & Co., of New York City, send us the subjoined data: "We are operating only one large truck. It has been in use steadily for a little more than eight months, and has given very good satisfaction. It runs daily from our salesrooms on Nineteenth Street down town to the Battery, and up town to One Hundred and Twenty-fifth Street, covering both the East and West Sides, and makes from 100 to 125 deliveries a day. The cost of the service, including the investment and the depreciation of the value of the truck because of wear, does not exceed the amount it originally cost us to do the same work with horses and wagons. As soon as we have completed our first year's use of the vehicle we shall be able to give you actual figures, showing the comparative cost between the two methods."

Kent-Costikyan, Persian rug importers in New York, say: "We have recently purchased an automobile truck, but have had it so short a time that we prefer not to make any positive statements yet, but that it appears in every particular to be satisfactory. It has shown a capacity to do a great deal more work than was accomplished by our horse truck, and if, after further trial, it continues to give as much satisfaction as now we shall probably purchase others."

A special form of service or duty is that required by the New York Railway & Steamship Time Table Company, whose Mr. J. E. Wyman writes as follows of the results of about three months' practical use: "We are much pleased with the results from the working of our auto car, which has attracted so much attention, not only in New York, where it is used, but all over the country. The car was designed by myself and built by the Vehicle Equipment Company, in Brooklyn. It is built most substantially, the bed being constructed of steel with sufficient strength that with flange wheels substituted it could be placed on a railroad track in a regular train and do its share of the work.

"During the two months' service the cost for repairs have been less than ten dollars, that being mostly for broken jars in the battery and the wearing out of two small pinions on the end of the motor shaft.

"It is my personal opinion that the question of motor trucks has been solved. I believe that it is perfectly practical now, but of course will continue to be improved, especially in the batteries, for all time to come."

Saks & Co., a dry goods house in New York City, with widespread retail trade, have had the following experience: "1st. We are using at present twelve (12) electric autmobiles. 2nd. We have no means of compiling the exact amount of work performed by each wagon, but would state that in our opinion they are doing work somewhat in excess of what could be done with a horse and wagon. 3rd. The

cost is now, exclusive of repairs, $35 per wagon a month, for stabling and current. 4th. The replacements and repairs amount to $20 a month per wagon. 5th. We feel that the success of an automobile delivery system depends to a great extent upon the care which the wagons receive. If in charge of the proper people, an automobile delivery service can be made a success, but not otherwise." In like manner, the Hard Manufacturing Company, of Buffalo, write us: "We have one electrical truck in use and consider that it does as much as two or three ordinary wagons. The actual cost to run it, it is rather hard to determine, as we have our own charging plant and run the engine anyway. We should think it would compare quite favorably, however, with the cost of a single wagon. As to our general feeling on the subject of the success or failure of this electric vehicle, the enormous increase in the number used testifies to their efficiency. Thirteen are about to be used here by one of the express companies."

A batch of electrical and mechanical concerns reporting may next be considered. Mr. G. C. Allen, superintendent of construction of the New York Telephone Company, whose truck we illustrated and described not long ago, says: "We have but one automobile and that your issue of March 28, this year, fully described. The automobile is primarily used to pull underground cables into the subway, thus substituting power for manual labor, and it is in this use that we effect a very large saving in the cost of laying cables. The vehicle is maintained, under contract, by the people of whom we purchased it, and I am, therefore, not able to furnish you with the various cost items. We figure that the total cost per year to us, including interest on investment, depreciation and maintenance, but not including the operator, is about $1,900. It has been in use since the first of the year and has given satisfactory service." The next letter is that from the hardware concern of Hammacher, Schlemmer & Co., of New York City, as follows: "We have one three-ton truck making an average of 25 miles per day with one charge. The actual cost for eight months' service is an average of $37.50 per month. This truck we have used since September, 1902, and up to the present writing feel that it is a good addition to our equipment. Although making an average run of 25 miles per day, it has required comparatively little repairing, and we have found it serviceable in stormy weather. It requires of course good care, but when proper attention is given it, our experience is that little trouble will arise. We have used horses exclusively up to the time this truck was purchased and apparently the truck will be as cheap as the horse, but we have not used it long enough yet to determine this feature definitely." The third letter of this class is from the well-known house of Niles-Bement-Pond Company, who speak of experience in handling machine tools in New York City. Mr. Walter Y. Clark, vice-president, writes us as follows: "We have had one 6-ton electric truck for about eight months, and we hardly feel competent yet to compare the results, so far as expenses are concerned, with horse-drawn vehicles. There is no doubt that the electric truck gets about the city more rapidly and hence does more work. The cost of restoring the batteries is approximate to that of feeding a pair of horses. The depreciation of battery and tires is quite rapid, and this expense of renewal is considerable; whether more or not in the long run than with horses may be questioned, although our experience is rather unfortunate in this respect. We find, as probably others have, that the tires are short-lived and very costly, ours costing $90 apiece. Probably in a city that was reasonably well paved this would not be so great an element of cost. Especially with a heavy truck our very rough streets are particularly hard on tires.

"Except for this vulnerable point, we would unhesitatingly predict a very large use for these trucks in the near future. They are rapid, noiseless, and take up very much less space than horses, which is an advantage in getting about in crowded streets, on docks, etc., and also for storage purposes, to say nothing of the advantage of their cleanliness to the city at large."

In the same category of well-informed mechanical concerns may be put Sackett & Wilhelms Lithographing Company, of Brooklyn, who remark: "We would state that we have three electric vehicles, two of which are heavy delivery wagons of four tons' capacity, and a combination passenger and parcel delivery wagon. So far our large wagons have moved large amounts of material and were especially valuable in our recent moving, from New York to Brooklyn. We are handling most of our deliveries now with the electrics. So far we have been unable to determine the actual cost of the service. We have our own generating system and our facilities for charging are especially favorable; our current does not cost more than three cents per kilowatt-hour. We feel that one of the great drawbacks to the use of this class of truck is the replacement of gears and batteries and the high charge for such replacement. Besides this, the initial investment is high and consequently the interest and depreciation charges are also high.

"It would seem that improvements can be made in the gearing to exclude the dirt by applying a suitable gear case. Our general feeling as to the success of this class of vehicle is that providing the repair bills can be kept down and with power taken from one's own plant, there seems to be no other reason why electric trucks shall not prove a desirable investment."

The Hall Safe Company has made a practice for some time past, as already noted in these pages, of handling safes in New York City, in electric vehicles, hauling them to and from the spot, and hoisting them in and out of buildings by auxiliary motor. They say: "We have had a truck in service for nearly two years. It has been satisfactory to us in every way. We find that the greatest advantage to us is the ability of the wagon to do hoisting with its own power. It can do hoisting work four to five times quicker than we can do the same by hand, and can make about two to three times as many deliveries as a double-team truck. The cost of maintenance is from $18 to $25 per month for electricity and wear and tear of about $1 per day. We are in every way well pleased with this vehicle and think that for any business in which there is both hauling and hoisting, such as ours, that it is a great saving and convenience."

On the other hand, the experience of Mr. Henry Heide, the confectionery manufacturer, is not quite so satisfactory, for he remarks: "I cannot say as much in favor of my automobiles as I would like to. It would be all right if there was not so much difficulty with repairs, which adds considerably to the expense as well as preventing as free use as we would like to make of it. I only have one electric truck and this does about as much as a double and a single truck. Whether the cost is any more or less, I cannot quite state as yet, because the truck is only in operation about nine months. My general feeling on the subject is that before electrical vehicles for business purposes are entirely satisfactory, considerable improvements must be made, particularly in regard to the storage battery. One of my objects in investing in my truck was to make the far-off deliveries, such as East New York, etc., in order to save the horses during the hot weather. In making these trips, however, I find that we run out of electricity occasionally before we reach home." Another point of view, again, is that furnished by Montgomery, Ward & Co., the famous "mail order" people, of Chicago: "We have to say that we have but one electric truck in commission at present, although we have several more ordered, undelivered. The one we have had in use during the past three weeks has so far proven very satisfactory, the work that it does being all that we could expect. It handles almost double the amount of freight that a team-draw truck can do in a given length of time, and at less expense for maintenance. We find, however, some objection to it among the teamsters and the Teamsters' Union, of Chicago, who seem prejudiced against an innovation of this nature, but we believe that within a short time, by diplomatic conduct, this prejudice will be done away with and machines electrically equipped will prove successful and extensively used in this and other cities of the West."

John B. Ellison & Sons, of Philadelphia, writes: "We are using one electric wagon, for delivery of packages from our New York store, and the amount of work done by it is considerable, as it covers practically the whole business section of the city, each day. The actual cost we find to be about the same as we formerly paid for hauling by means of horse and wagon. We are very well satisfied with the work that our electric wagon is doing, as it covers more ground in less time than by our former method of delivering." Goldenberg Brothers & Co., importers, New York City, say: "We have two electric delivery wagons, which we use daily from 8 A. M. to 6 P. M., almost continually. As to the probable or actual cost of the service we can give you no definite information at present, as we have not had them long enough to give any accurate estimate. We feel thoroughly satisfied with the service we are getting from them, and they are a success as far as our use of them up to the present has demonstrated." In this connection, C. C. Shayne, the furrier, of New York City, says that the electric truck bought last November is very satisfactory and that they can do more work with it than with a wagon and team of horses.

A batch of brewers may next be considered. The Isaac Leisy

Brewing Company, of Cleveland, say: "We have been using our electric truck since February daily, making from two to three trips per day. Since it has been running we had no repair bills to pay. The capacity of the truck is 5 tons, and we can recommend the electric truck as giving entire satisfaction." The Christian Feigenspan lager concern, of Newark, N. J., write: "Our experiment has hardly been of sufficient duration to give us an idea of the practicability of the machine. So far as making deliveries in good time and covering distances is concerned, everything has been satisfactory. We have, however, experienced more or less tire trouble and some minor difficulties with our batteries in the line of breaking bands and defective cells. We are keeping very close watch of what our machine is doing, and, no doubt, in the course of several months, we will be able to get a better idea of the cost of repairs, etc., in order that we can make comparison between horses and the electric truck as regards expense of maintenance, etc., at which time we will be pleased to give you the result of our experiment."

A concern that has experimented a good deal in the truck line is the Moxie Nerve Food Company, of New England, from whose New York office we have the following data: "Our experience with electric trucks and wagons has not been very great. We have used during the last few years several steam machines of different makes with varied success, but on the whole they have not been satisfactory. We have found that there is something out of repair with them about all the time, and it requires a regular engineer to take charge of them. We have only one electric wagon. This wagon has been in constont use with us for over a year and has been used for various purposes, but usually to transport goods to our various stations, located in Harlem, Newark, Brooklyn and Mt. Vernon, and at the present time we are making two trips daily to One Hundred and Twenty-fifth Street, Harlem, and two trips to our Brooklyn station daily, loaded both ways. During our busy season last summer we used to use this wagon 16 or 18 hours a day and during the entire time it has only been laid up two days for repairs, which was for cleaning the battery. This is excepting an accident which occurred to the machine last season when it was run into by an electric car. The cost of maintenance so far has been very small, barring this accident. We should say that the cost of all the repairs so far had not exceeded $50. Up to the present time the machine has not required new batteries or tires, which of course will bring up the cost of maintenance considerably. We are not in a position to state at the present time just what it would cost for maintenance for an entire year.

"This class of vehicle has been entirely satisfactory to us and we shall probably install several more of them in the near future. One reason why these vehicles appeal to us in particular in this kind of a business is that when the weather is the hottest we are the busiest and have to cover our routes more often than any other time. It does not matter how hot the weather is, the electric wagon is ready to go and it can be pushed to its utmost capacity, as the weather does not affect it as it does horses."

Two letters reach us from Pittsburg. One is from the Ohio & Pittsburg Milk Company, which says: "We have one electric delivery wagon, which has capacity of 1,500 pounds. We consider that it does the work of what three single wagons would do. We have no idea of what the cost for operating it is as we have not yet had it long enough to give the average cost of expense on it. We think very much of the wagon and would certainly get more of them immediately if we were located in a level city. Our machine does all the work that is claimed for it, but these hills in this town are an awful strain on it; besides the streets are paved too rough for fast speed. For a city like yours we think they are just the thing." The other letter from Pittsburg is that of the Seely Manufacturing Company, who deal in and supply automobiles, and have a Westinghouse charging plant with a capacity of eight vehicles on charge at once. They say: "We have at present in use in Pittsburg three electric delivery wagons and one electric truck. One of the delivery wagons and the truck are at present doing as much work as any three teams, but the other two electric delivery wagons are smaller ones, and do not do as much work. In the former two instances, the expense of operating the carriage is practically nothing except the salary of the operator, which is about $60 a month, as both companies make their own power, and therefore their expense of charging is reduced to a minimum. We can only see one future for this class of vehicle, and that is a successful one."

It will be seen from the above voluntary testimonials that the electric truck situation is far more cheering and hopeful than many of our readers have been inclined to believe, and that the attitude of the purchasing public toward them is thoroughly cordial.

Improvement in Searchlights.

The accompanying illustrations show searchlights with a new and improved device for spreading or converging the light at will by means of dispersion lenses. The lenses are mounted in two light brass semi-circles, as shown in Fig. 1. These semi-circles are pivoted

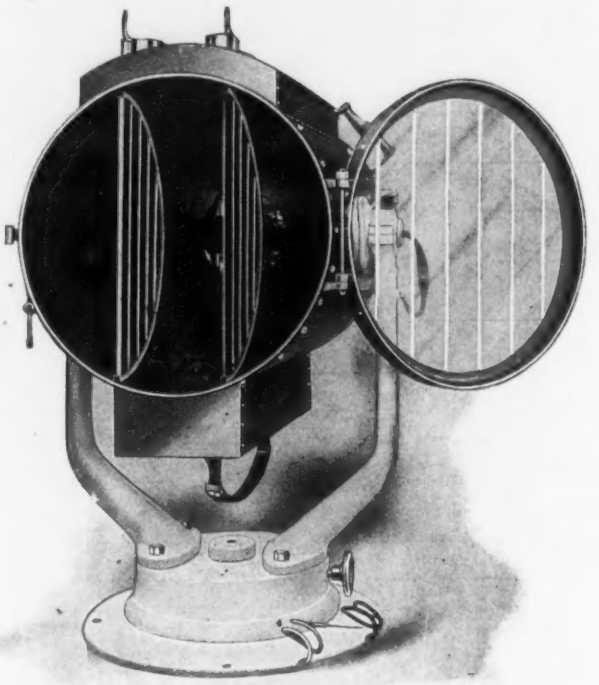


FIG. 1.—SEARCHLIGHT.

so that they may be rotated through an angle of 90°, or a quarter circle. The two small handles shown on the top of the cylinder are for turning the lenses. When placed in the first position the lenses

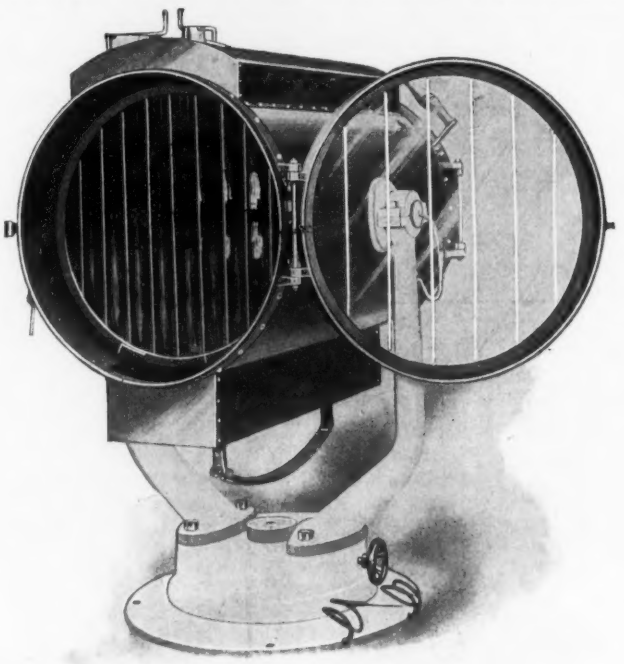


FIG. 2.—SEARCHLIGHT.

present a surface only one-half inch thick to the rays of light. This small amount of surface detracts nothing from the brilliancy of the light which emerges in a solid straight beam. By turning the handles through an arc of a circle of 90°, the lenses are swung around as

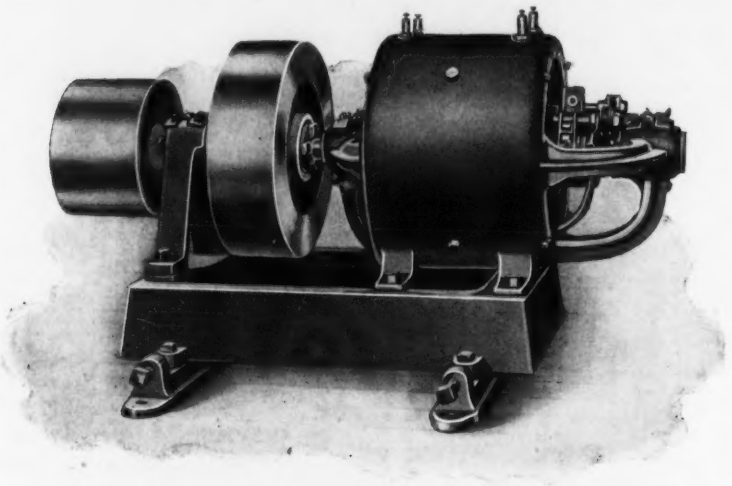
shown in Fig. 2. All the light has to now pass through the lenses, and it is spread out according to the curvature of the lenses.

It might be added that the dispersion lenses are permanently mounted in the searchlight cylinder, and trimming, cleaning, etc., are readily accomplished without removing them. The door containing the plane glass is left in position and not removed at all. In the illustrations the glass door has been purposely swung back to show the interior of the searchlight.

These searchlights are made by the Carlisle & Finch Company, Cincinnati, Ohio.

Gas Engine Type Dynamos.

The most exacting service required of a gas engine is in driving an electric dynamo. The explosive nature of the discharge tends to

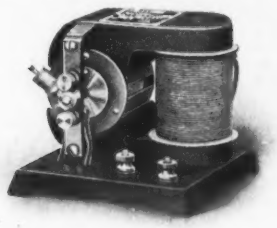


GAS ENGINE TYPE DYNAMO.

make an unevenness in the power, showing itself in a flickering of the light. A solution of this condition is offered in the dynamo illustrated herewith, which is manufactured by the Hobart Electric Manufacturing Company, of Troy, N. Y. In it the weight is applied where most effective, and the fly-wheel is sufficiently heavy to carry over the irregularities of any gas engine. A fly-wheel of this size requires the additional support of a third bearing. The manufacturers state that hundreds of these dynamos are now in constant service with a great variety of gas engines under widely varying conditions, but up to the present no engine has been found, however, impulsive or irregular in its speed, that will not give a light when connected with the dynamo free from the annoying fluctuations which affect the sight and nerves.

Power Motor.

The accompanying illustration shows a power motor manufactured by Messrs. J. Jones & Son, 64 Cortlandt Street, New York City. In its design it follows the lines of machines for use on electric lighting circuits. With a set of dry batteries it supplies an outfit for the operation of sewing machines. Among other uses to which it may be



POWER MOTOR.

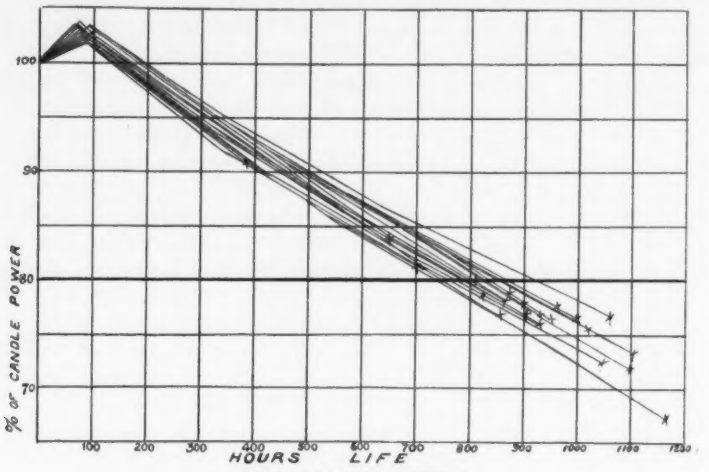
applied are the driving of models, jewelers' lathes, dental drills, phonographs, etc. In design and mechanical construction it is stated to be in every respect equal to larger power machines. The fact that it is adapted for use in connection with a dry battery is a strong recommendation for its application to many domestic purposes.

An Improvement in Incandescent Lamps.

From the beginning of incandescent lighting a point in economy of the incandescent lamp to which considerable attention has been given is that relating to the decline of candle-power and current efficiency with the life of the lamp. As far back as ten or more years ago it was pointed out that after a lamp has reached a certain age it is economy to "smash it" and substitute a new lamp. This conclusion followed from the fact that aside from the reduced illumination, the cost per unit of light increased largely beyond a certain life.

In most of the large central stations the policy has been adopted of removing lamps when they have declined to 80 per cent. of the initial rated candle-power. As lamps may continue to burn at still further reduced candle-power and still less efficiency for hundreds of hours beyond this point, it will be seen that to carry out this method properly involves either photometric measurements of lamps in service—which is impracticable—or keeping a life record of all such lamps.

The Bryan-Marsh Company announces that as the result of a study

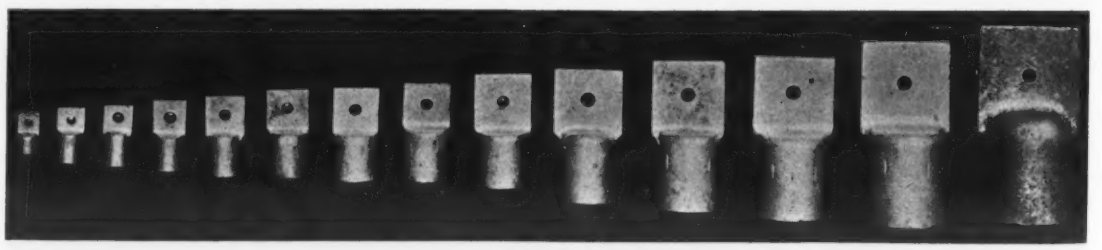


CANDLE-POWER CURVES.

of the characteristics of incandescent lamps affecting their life, it has been enabled to develop a lamp which exhibits the remarkable and important property of burning out when it has declined approximately 20 per cent. in candle-power. The accompanying curve was constructed from a test of 16-cp, 3.5-watt lamps of this type, the actual average efficiency being about 3.41 watts per candle-power. It will be noted that the burning out appears to occur a little below the 80 per cent. line, but this is obviously better than having a sharper decline in candle-power during the early period of life, and then holding on to a burning out point which in most lamps is not reached until the candle-power has declined to from 60 to 70 per cent. of the initial rated candle-power. The candle-power curve shows that the average hours in which the Bryan-Marsh lamp reached 80 per cent. were 813, while the average hours to the point of burn-out were 914. While the lamps thus lived 100 hours beyond their useful life, this is a great advantage over lamps which, while not having a longer life, during that life drop from 30 to 40 per cent. of their initial candle-power before burning out.

Cast Copper for Castings for Electrical Apparatus.

The many places where copper castings for electrical apparatus can not only be used to much better advantage than rolled copper



COPPER CASTINGS.

from the point of mechanical construction, durability and economy, but furthermore, are absolutely necessary, will readily occur to the electrical engineer. In the past, the great objection to such castings has been their decreased conductivity as compared with rolled copper. As everywhere else, the great desideratum has been the

use of a composition such that all electrical losses would be reduced to a minimum. This is particularly true where large currents are handled, as is realized by all who use electrical devices; and the best is none too good both from the point of economy and perfect operation.

The J. Lang Electric Company, Chicago, announces that after many years of research and experimental work, it has succeeded in perfecting a process by which copper can be cast and yet retain its solidity and electrical conductivity. In fact, it is said that with castings made according to the company's process the conductivity is one-third to one-half greater than with any others produced on a commercial scale. The castings are perfectly solid, and can be made of any size or shape. The company is also making use of these in its entire line of switches, table-boards and other devices manufactured by it.

Cleaning Boilers.

One of the methods of cleaning boiler tubes is to rap the tube so as to give it a frequent but not severe vibration, in such a manner that the more brittle and non-elastic scale formation is shaken off, without any strain being sustained by the tube.

The General Specialty Company, 70 Carroll Street, Buffalo, N. Y., has devised a machine for boiler cleaning purposes in which the motive power is applied in the most direct manner, thus insuring the greatest speed of piston. The double-acting knocker rod is firmly secured to the former, and the travel of the knocker rod is so limited that though it is capable of exerting a sufficiently hard enough blow on the tupbe, it cannot puncture it or injure it; because even though the tube were not present to stop the motion of the rod, it would not travel beyond the point where the walls of the tube would be. This construction

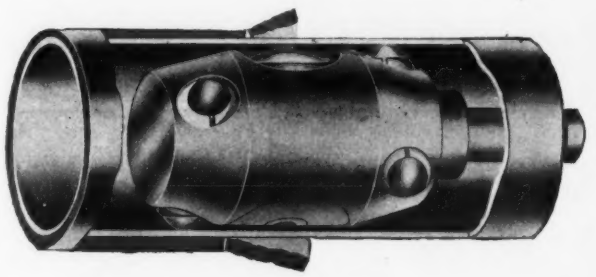


FIG. 1.—BOILER TUBE CLEANER.

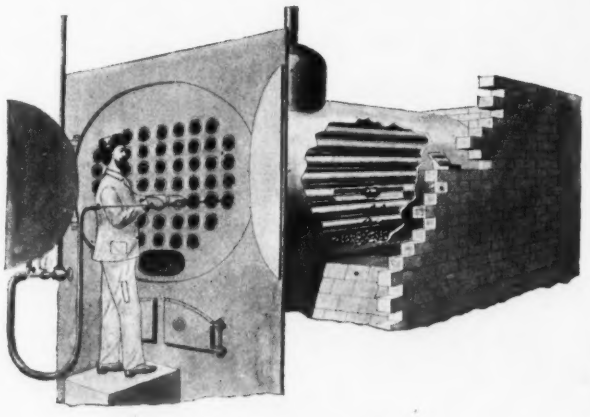


FIG. 2.—BOILER TUBE CLEANER.

makes it possible to safely operate the machine at boiler pressure, thus obviating the necessity of using a separate steam gauge, or a reducing valve to lower the pressure.

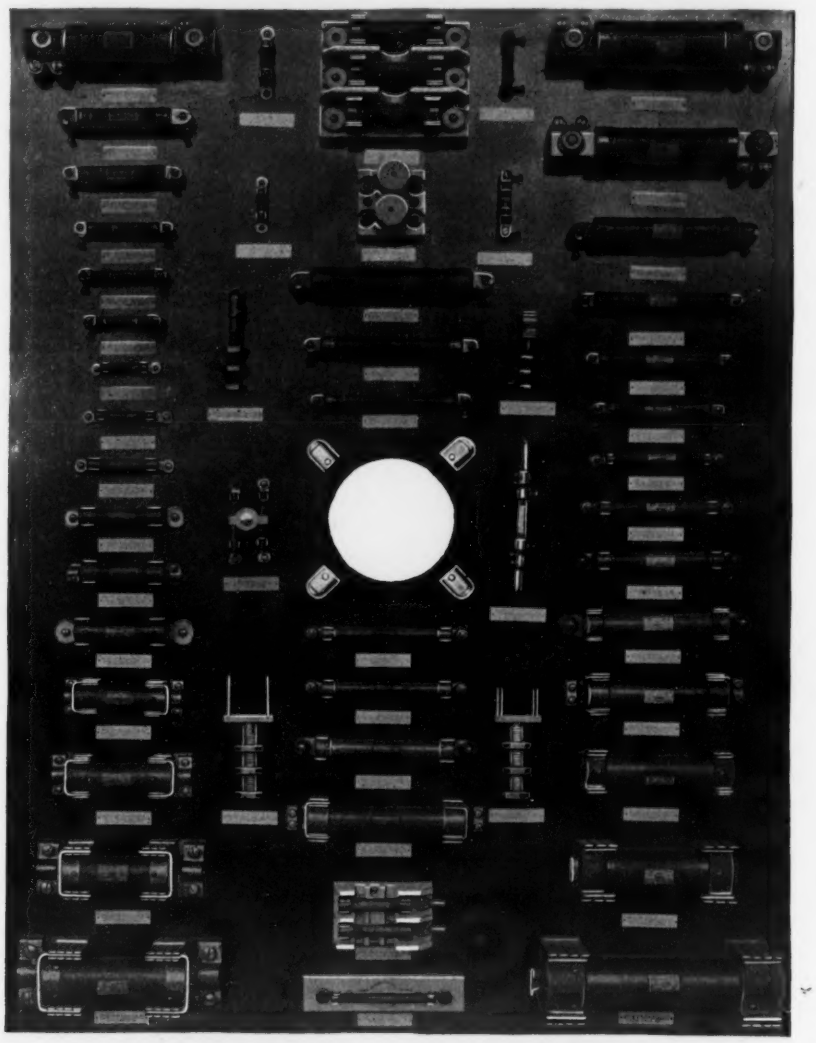
For obvious reasons, the body of the machine must be made considerably smaller than the inside diameter of the tube, and this, in connection with the rest of the construction, necessitates some means for accurately maintaining the machine in the axis of the tube. This is accomplished by two sets of centering lugs, one ahead and one back of the piston, which are forced out against the inner surface of the tube by steam pressure.

The undue heating of the tube operated on is further avoided by so using the steam that it is expanded to such a point before exhausting into the tube that its temperature is only a very little above the atmosphere.

An actual test of this machine has shown a speed of 3,000 strokes and upward per minute, according to the pressure used—nor was the temperature of the tube at the end of thirty minutes raised so much but what it could be easily handled without gloves.

Enclosed Fuse Protective Devices.

No recent development in electrical construction devices has met with more rapid advancement and success than the so-called enclosed fuse, which is to-day supplanting nearly all forms of open fuse protective devices. Actual commercial exploitation was begun but a few years ago, yet at present the variety of styles and types of enclosed fuse protective devices is surprisingly extensive and covers almost every branch of electrical service. This is indicated by the illustration herewith, which shows some of the different types and styles of "Noark" enclosed fuses and cut-outs, which type is made by the H. W. Johns-Manville Co. It is also of interest to note the large ampere sizes to which these fuses have been developed on the various voltages in common use. Recent tests made of "Noark" fuses on a 4,000-amp.-hour storage battery at 250 volts have demonstrated the entire efficacy of fuses whose normal carrying capacity was 400 amp. at 250 volts (100,000 watts). These fuses were short-circuited dead on the terminals of the battery and operated absolutely without smoke, flash or any demonstration whatever, yet indicating upon the exterior of the tube their interior condition. Larger sizes are now being developed, and it is expected that they will be furnished up to 1,000 amp. in the near future. As a circuit-rupturing performance, the opening of the enclosed fuse capable of carrying 500 or 600 amp. at 250 volts absolutely without any external demonstration or explosion whatever, and without in any way affecting the integrity of the tube or external structure, is certainly nofeworthy.

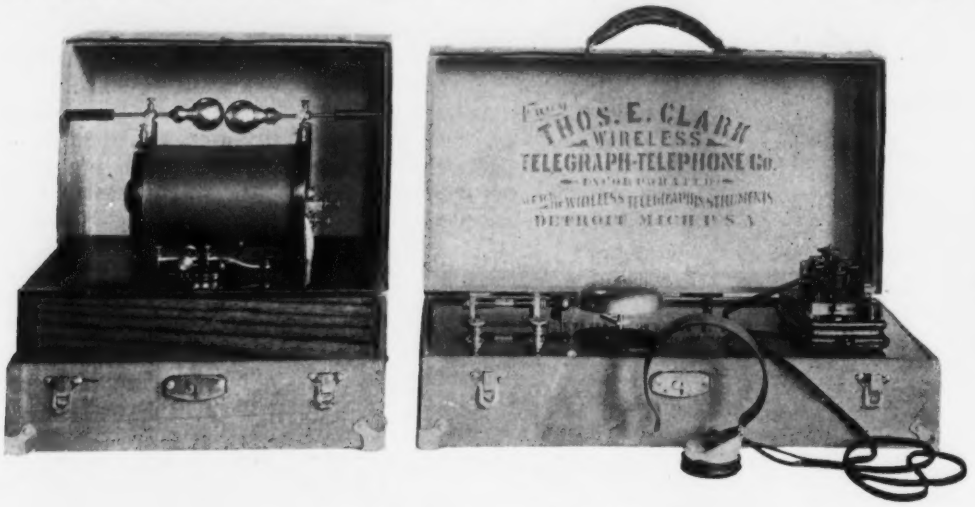


ENCLOSED FUSE PROTECTIVE DEVICES.

Wireless Telegraph Instruments.

By Ackland Stiling.

The accompanying illustrations show a set of wireless telegraph instruments made by the Thomas E. Clark Wireless Telegraph Company, of Detroit, Mich. Fig. 1 is a transmitting instrument consisting of a transmitting transformer, dry batteries, telegraph key and adjustable spheres or spark gap. As will be seen, the parts are tastefully arranged and are mounted on a piano-finished, hardwood base. All the unsightly parts and electrical connections are concealed, the spark-gap, sphere, coil proper and key being only exposed to view. The dry batteries supplying the energy to the coil or transformer, are located in the lower part of the case.



FIGS. 1 AND 2.—WIRELESS TELEGRAPH APPARATUS.

The transmitting coil is of the Clark high-frequency transforming type, with primary and secondary, the insulating material being of the highest grade. The core is so constructed as to prevent the usual loss through eddy currents. The condensers are especially well insulated. The vibrator, seen at the end, is fastened securely to the coil head, and is supplied with heavy platinum contacts; it is so constructed that the adjustment, once made, is constant.

The coil is mounted on hard-rubber brackets with polished heads. The secondaries terminate at the tops of the head ends. The telegraph key is connected in the battery circuit, and when used by the operator in transmitting messages in the Morse Code of dots and dashes, it excites the primary of the coil or transformer, thereby causing rapid current alternations in the secondary, which give rise to discharges at the sphere gap. The spheres are mounted on pillars of polished insulating material. The secondary of the coil is connected, as well as the aerial capacity, with a ground on a gas or water pipe. The aerial wire is otherwise insulated from the ground by means of a bamboo fish pole, a hammock or wire cord suspended by means of brass hooks holding the bamboo.

The receiving instrument (Fig. 2) is made up of the following parts, mounted on an oak removable base: An adjustable Clark sealed coherer with a neat receiving stand or clip, which supports the coherer and acts as connecting or disconnecting switch as well; a special wound split core relay of the Clark type, with automatic tapper; and condenser and shunt coils. The batteries for the receiving and tapper circuit as well as the shunt coils, condensers and tapper, are all concealed in the case underneath the shelf panel; the relay head band receiver attachment, gong, coherer and binding posts for aerial and ground connections, together with circuit switches, being the only parts visible.

Both instruments may be transported as easily as a dress suit case, being very compactly enclosed in a drab color case. A tape-writing device can be used instead of the microphonic receiver if desired; with some practice, however, messages can be received faster with the latter.

Pocket Volt Ammeter.

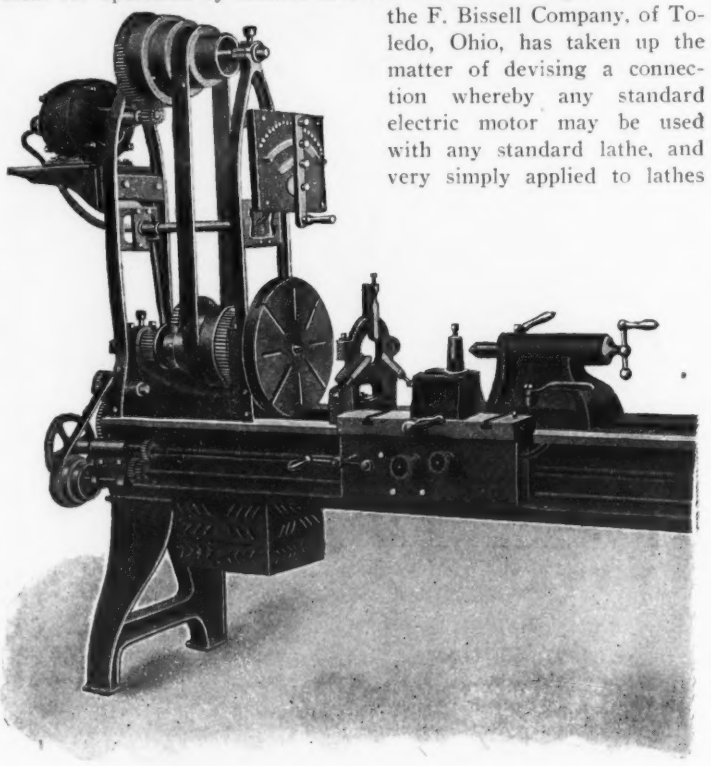
There has been a good demand for a small, accurate moderate-priced ammeter and voltmeter for testing batteries, especially in the case of electric ignition of gasoline engines. To meet this demand, the Atwater-Kent Manufacturing Works, 120 North Sixth Street, Philadelphia, have brought out a combination instrument which is designed and calibrated especially for testing each cell separately. The ampere scale reads to 20 and the voltage scale to 5. The voltage test is made by placing the two pliable leads furnished with each instrument, on the terminals of the battery, and the amperage test is obtained by simply pressing the button on the instrument, without changing the leads.

The needle is light and delicately pivoted, and is as nearly dead beat as is possible to make a small accurate instrument. But two seconds are required to bring the needle to rest. The instrument is of particular service for use with gasoline automobiles and launches, as it shows exactly the condition of the battery. It is substantially constructed on scientific principles and on the workmanship no pains have been spared.

POCKET AMMETER.

Motors for Driving Standard Machine Tools.

In the discussion of the direct-connection of electric motors to individual machine tools, it is usually taken for granted that the machine tool will be adapted for such connection; in other words, that the usual design of tools will be sufficiently departed from to fit them for operation by electric motors. It is interesting to note that the F. Bissell Company, of Toledo, Ohio, has taken up the matter of devising a connection whereby any standard electric motor may be used with any standard lathe, and very simply applied to lathes already in use and driven by belting. The accompanying illustration shows a lathe thus fitted. By this method the manifold advantages of the electric drive may be secured without the expense of purchasing and installing a new lathe.



MOTOR ADAPTED TO LATHE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Dullness characterized the stock market throughout the week and the volume of transactions was at a low level. The public is holding off and large professional operators were inactive. The market was devoid of feature, though further declines were noted in industrial specialties. The interior is beginning to call for funds with which to move the crops and considerable foreign money was loaned. The United States Steel stocks were rather heavy though not active, and there was quite a little manipulation in Amalgamated Copper, which to some extent reflected the strength of copper stocks in the London market. The downward movement of tractions was checked, and there was a firmer tendency. Brooklyn Rapid Transit made a net gain of 1¾ points, closing at 45¾, which was a fraction below the highest point of the week. Metropolitan Street Railway closed with a gain of ¾ of a point, at 114, this being ½ point below the highest figure of the week. There was little business done in General Electric, but it was on an advancing market, the closing price being 164, which was also the highest of the week, and a net gain of 2 points. Western Union closed at 83¾, ¼ of a point higher than the closing quotation of last week. Following are the closing quotations of September 1:

NEW YORK.

	Aug. 25	Sept. 1		Aug. 25	Sept. 1
American Tel. & Cable	79	79	General Electric	162	163
American Tel. & Tel.	..	133	Hudson River Tel.	..	..
American Dist. Tel	25	23	Metropolitan St. Ry.	113¾	114¼
Brooklyn Rapid Transit	45⅝	45½	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	15	11	Marconi Tel.	..	3
Electric Boat pfd.	40	40	Western Union Tel.	84⅛	83¼
Electric Lead Reduction	1¼	1¼	Westinghouse com.	165	164
Electric Vehicle.	6	6	Westinghouse pfd.	170	170
Electric Vehicle pfd	9	8			

BOSTON.

	Aug. 25	Sept. 1		Aug. 25	Sept. 1
American Tel. & Tel	134	133	Western Tel. & Tel. pfd.	80	82
Cumberland Telephone	..	..	Mexican Telephone	1¾	1¼
Edison Elec. Illum.	..	..	New England Telephone	123	123
General Electric	162½	..	Mass. Elec. Ry.	21⅛	21⅜
Western Tel. & Tel	13	13	Mass. Elec. Ry. pfd.	79	80

PHILADELPHIA.

	Aug. 25	Sept. 1		Aug. 25	Sept. 1
American Railways	..	..	Phila. Traction	95⅛	95⅛
Elec. Storage Battery	57	56¼	Phila. Electric	6⅝	6⅝
Elec. Storage Battery pfd.	57	56¼	Phila. Rapid Trans.	..	..
Elec. Co. of America.	8⅛	8¾			

CHICAGO.

	Aug. 25	Sept. 1		Aug. 25	Sept. 1
Central Union Tel.	..	..	National Carbon pfd.	95	88
Chicago Edison.	..	..	Metropolitan Elev. com.	..	..
Chicago City Ry.	165	165	Union Traction	5	4
Chicago Tel. Co	123	.	Union Traction pfd.	30	..
National Carbon	26	20			

BROOKLYN RAPID TRANSIT.—The published statement of Brooklyn Heights earnings shows a surplus equal to 1.67 per cent on Brooklyn Rapid Transit stock. This is not, however, a true presentation of the results for the year on Brooklyn Rapid Transit stock since certain items, notably the interest on Brooklyn Rapid Transit bonds, are not shown in the report of the operating company, but everything considered it is not improbable that the full pamphlet report of the Rapid Transit Company will show results about as good as those indicated by that of the Heights Company. The most notable feature in the statement is the increase of $832,000 in gross earnings being a growth of 7.2 per cent over the preceding year. Operating expenses figure 61.1 per cent of gross, but when the property becomes thoroughly modernized it is not too much to expect that this should be reduced to 50 per cent. Such a rate for operating last year would have meant a surplus larger by $1,374,919 than that actually shown or an additional 3 per cent on Brooklyn Rapid Transit stock.

BELL TELEPHONE FINANCES.—Some interesting figures have been made on American Telephone & Telegraph finances. At $50 per subscriber, the Bell companies will this year earn about $70,000,000 gross and $19,000,000 net. The direct net earnings of the American Telephone & Telegraph Company, from its long-distance service this year will probably be $2,000,000. Adding one-half the net earnings of the sub-companies, $9,500,000, the result is $11,500,000 net earnings of the parent company. This is equivalent to 10 per cent on the $109,685,000 stock eligible to dividends this year, and to 8 per cent. on the $131,628,200 stock issued. The money expended for new construction will probably yield about 10 per cent. In 1902 construction expenditures by the Bell companies were $37,336,000. The output of instruments was 624,714, and the number of new subscribers was 257,336. At $50 per subscriber, the gross earnings from new construction would be $12,866,000, and net earnings (29 per cent. of gross) $3,730,000, or about 10 per cent. of the amount spent for construction.

ELECTRIC BOAT.—The directors of the Electric Boat Company have declared the first dividend on the company's preferred stock, an event which had been long looked forward to by many of the stockholders. The dividend is a quarterly one, and amounts to 2 per cent, being payable October 1. A director of the company stated that the dividend for a full year has been set aside in bank so that there may be no question of a continuation of these quarterly payments for a twelvemonth at least. The company is said to be doing a very satisfactory business with various European governments, which have purchased a considerable number of the submarine boats manufactured by the company, and it is from this source that the Electric Boat Company derives its principal profit.

INTERURBAN STREET RAILWAY.—It is reported that the financial departments of the constituent companies of the Interurban Street Railway are to be consolidated under the general direction of a comptroller, an office recently created, and that C. N. Duffy, secretary and auditor of the Chicago City Railway Company, has been selected to fill the new office.

WESTERN TROLLEY ROADS PROSPEROUS.—It is stated that all of the trolley lines throughout Ohio, Indiana and Michigan will show phenomenal earnings for August. Six of these interurbans will show over 30 per cent. increase when compared with last year and 20 when compared with July of this year. One line shows an increase of 50 per cent.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade conditions appeared to be somewhat irregular, due to the backwardness of crops in some sections, damage reports from others and uncertainty as to the monetary outlook. The best reports as to corn crop results came from the Southwest. Insect damage in Texas has given a less satisfactory turn to cotton crop reports, which are, however, still better than last year's. Fall trade in favorably-situated sections compares well with that of a year ago. There are still complaints of car congestion. In the iron trade some uncertainty is still noticeable, although there is a somewhat better feeling in the trade, and it is thought that prices have reached the lowest level. Trade reports from St. Louis, Kansas City and most Southern points are highly satisfactory as regards fall trade in dry goods, shoes, hardware and lumber. At Chicago business is better and more buyers from Kansas, Nebraska and Iowa are in the city. The lumber trade is picking up somewhat. Railway gross earnings for the first three weeks of August will exceed those of 1902 by about 12 per cent. The business failures for the week ending August 27, as reported by *Bradstreet's*, numbered 142, against 166 the week previous and 140 the corresponding week last year. In copper there were signs of weakening on the part of certain members of the latest bull movement. It is said that official figures are being cut from ⅛c. to ⅜c., according to grade and other conditions, and that consumers are still buying from hand to mouth. The closing official quotations are as follows: Lake, 13¾c. to 13⅞c.; electrolytic, 13⅝c. to 13¾c.; casting stock, 13⅜c. to 13½c.

NIAGARA FALLS POWER.—The Niagara Falls Park & River Railway Company, in Victoria Park, Niagara Falls, Ont., is greatly increasing its output of power for railway purposes. For some years past, two big generators in this power house have been run to supply power for the customers of the Canadian Niagara Power Company. On July 1 the leases for these machines expired, and since that time they have been removed, and are being replaced by new machines of much greater capacity. New dynamos for railway purposes will also be installed.

BALL ENGINE ORDERS.—Dravo, Doyle & Co., Pittsburg representatives of the Ball Engine Company, Erie, Pa., have recently received an order from the National Tube Works, Pennsylvania Department, for a 700-hp horizontal cross-compound Corliss engine, direct-connected to an alternator. The Birmingham Water Works, of Birmingham, Ala., are about to install two 100-hp, direct-connected engines furnished them by the Ball Engine Company.

THE GOUDY-McLEAN COMPANY, 120 Liberty Street, New York, which concern acts as export sales manager for a number of American manufacturers of electrical equipment, supplies, etc., is about to send a representative to the Hawaiian Islands, China and Japan, the Philippine Islands, Australia and India, with a view to opening agencies in those parts of the world.

AUGUST FAILURES.—R. G. Dun & Co. report 812 commercial failures in the United States in August, involving a total indebtedness of $10,877,782. In the corresponding month last year there were 840 failures, but the liabilities were only $8,068,525. An interesting feature of the report deals with manufacturing failures. In August of this year these numbered 241, and involved $7,748,685, as against 213 last year, involving $2,762,180. In other commercial lines the losses were below those of August, 1902. In trading there were 544 defaults, with aggregate liabilities of $2,946,352, compared with 580 in August last year to the amount of $3,333,158. Of banks and other fiduciary institutions, eight suspended this year, with liabilities of $871,075, and last year four similar defaults involved $1,108,750. The analysis shows, therefore, that in manufacturing industries alone were the losses more severe than in the corresponding month last year. All the excess over the losses in August, 1902, was caused by a few large failures in iron and machinery. The total losses in August were larger than in the corresponding month of any other year since 1896, but the excess occurred in manufacturing only.

THE MEXICAN LIGHT & POWER COMPANY, LIMITED, of which James Ross, of Toronto, is president, and F. S. Pearson is vice-president and chief consulting engineer, reference as to whose project to transmit electric energy from its huge plant now under construction at Necaxa, State of Pueblo, to Mexico City and neighborhood, a distance of some 90 miles, has appeared from time to time in these columns, has just decided to generate power at the same plant for transmission to El Oro and Tlalpujahua for the purpose of operating the several extensive mines in those regions. No details regarding the quantity of power to be called into requisition are yet available, but it is understood that they will be completed within the next week or so, and that the company's engineers will soon be on the field making surveys for the new transmission line, which will be more than 100 miles in length.

STROWGER TELEPHONE EXCHANGES.—The Automatic Electric Company, of Chicago, reports that its installing forces are now engaged in equipping the following plants with Strowger automatic telephone apparatus: Citizens' Telephone Company, Grand Rapids, Mich., 5,000 stations; Northeastern Telephone Company, Portland, Me., 2,500 stations; St. Marys Telephone Company, St. Marys, Ohio, 500 stations; Cleburne Telephone Company, Cleburne, Texas, 640 stations; Southern Telephone Construction Company, Columbus, Ga., 700 stations; University of Illinois, Urbana, 50 stations; University of Chicago, 50 stations; Armour Packing Company, St. Louis, Mo., 45 stations; Union Telephone Company, Limited, Woodstock, New Brunswick, Canada, 110 stations. All of these will be in operation in a few weeks.

CROCKER-WHEELER ORDERS.—The National Malleable Castings Company, of Chicago, has recently purchased a 300-kw generator of Crocker-Wheeler make for direct-connection to a Buckeye horizontal cross-compound engine. This new set will be used to replace four direct-connected units of foreign manufacture. The Malleable Castings Company has about 300 hp in Crocker-Wheeler motors for factory equipment. The Oliver Typewriter Company, of Woodstock, Ill., is adopting electricity for power. It has just placed a contract with the Crocker-Wheeler Company for a 130-kw generator and a large number of motors. Charles L. Brown, of Chicago, has been retained as consulting engineer for the installation of the equipment.

PROPOSED EXTENSIVE CONVERSION OF CHILIAN RAILWAY.—The Chilian Government Railway authorities are seriously considering the question of taking advantage of abundant water power by converting large sections of the steam railways in that part of the world into electricity. It is proposed to change the line running from Santiago, the capital of the Republic to Talca, located about 150 miles south. W. R. Grace & Co., 1 Hanover Square, New York, look after the interests of the General Electric Company, on the west coast of South America, while the business of the Westinghouse people is taken care of by J. K. Robinson.

INCANDESCENT LAMP FACTORY FOR MEXICO.—A factory is to be built in Mexico City which will be devoted to the manufacture of incandescent lamps in Mexico City. It will be the first plant of its description in the southern republic. A company has been organized in Mexico for the purpose of carrying on the enterprise. Its capital is $100,000. A. Chaillet, some time technical manager of the Shelby (Ohio) Electric Company, is primarily interested in the company. The initial capacity of the plant will be 1,000 lamps daily. Besides catering to Mexican trades, it is intended to make a bid for export business.

H. T. PAISTE CO.—The recent purchase of a pottery by the H. T. Paiste Co., of Philadelphia, together with the expansion of our electrical supply business, has necessitated the active services in the home office of the secretary, E. A. Jenkins. He has heretofore had charge of the Western office and warehouse, with headquarters at 190 South Desplaines Street, Chicago. The company has secured the valuable services of Mr. James Wolff, Western sales manager of the New York Insulated Wire Company, who will conduct the Paiste Western business at the same address in connection with his present well-known wire agency.

"SOO" POWER CANAL.—The engineer's figures name $35,000 as the actual cost of the repairs to the Michigan Superior power canal, at Sault Ste. Marie, and $45,000 as the cost of additional construction. At the time the leak occurred, months ago, exaggerated rumors had it that the cost would run high in the hundred thousands of dollars. The canal is stated to now be about in readiness for turning on the water again, whenever the management shall see fit. The Union Carbide, which under its contract is the biggest customer of the company for power, is expected to be ready for operation about October 1.

ISOLATED TURBINE EQUIPMENT.—The first isolated steam turbine equipment in Chicago has been started up in the packing plant of Schwartzchild & Sulzberger, the installation consisting of a De Laval turbine and a Northern twin generator. A test made was eminently satisfactory and promises much as being a satisfactory example of the practicability of steam turbine practice. The equipment will probably carry a 24-hour load, including the Sunday load. The day load will be shared with a generator unit driven by a reciprocal engine. The turbine equipment has a capacity of 200 kw at 900 r.p.m.

MACHINE TOOLS WANTED.—The Thomas E. Clark Wireless Telegraph & Telephone Company, of Detroit, Mich., has been doing so large a business it is compelled to enlarge its manufacturing plant, and it is now in the market for the necessary tools for making wireless apparatus. The plant required includes wood working machinery, brass working machinery, monitor and automatic lathes, etc. Mr. T. E. Clark, the president, has been in New York the past week on business connected with this increase of capacity, and speaks very hopefully as to the demand for wireless apparatus.

A MEXICAN TELEPHONE SYSTEM.—An extensive telephone system is to be constructed and operated by American interests in the City of Guaymas, Hermosillo and other cities located in the State of Sonora, Mexico. The Sonora Telephone Company has been organized under the laws of Arizona for the purpose of carrying out the project. L. W. Mix, Edward Titcomb, W. E. Bristol and C. C. Kingsley, all of Nogales, and F. E. Monteverde, of Hermosillo, are the principal parties interested in the undertaking. The company has power to operate elsewhere in Mexico if desired.

ANOTHER BIG MEXICAN HYDRAULIC PLANT.—A project is on foot to build another large hydraulic plant in the State of Jalisco, Mexico, for the purpose of generating electric energy for various purposes. The concession has been granted by the Mexican Government to Facundo Perez, of Mexico City. The franchise permits of the utilization of 10,000 liters of water per second from the Santiago River. The concessionaire is also authorized to build telegraph and telephone lines in the same State.

WIRE, SWITCHES, ETC., FOR JAPAN.—Francis A. Cundill, of 90-96 Wall Street, who represents the American buying interests of the British electrical engineering and contracting firm of L. J. Healing & Company, Yokohama, received orders by last mail for insulated copper wire, switches, etc., for shipment to the Far East. The wire will be supplied by the National India Rubber Company, of Bristol, R. I. The switches will come from the Perkins Electric Switch Manufacturing Company.

EQUIPMENT FOR SANYO RAILWAY, JAPAN.—The Sanyo Railway Company, through the Japanese house of Mitsui & Co., New York, has awarded an order to the General Electric Company for the 250-kw. alternating-current, three-phase, 60-cycle generator, for which American and European bids were called recently.

GERMAN LIGHTING EQUIPMENT FOR PEKIN PALACE.—F. C. Jenkins, an Englishman, but long domiciled in Germany, has secured the contract for the entire electric lighting plant to be installed in the Pekin Palace, China. The equipment will be of alternating-current type.

THE PLUNGER ELEVATOR COMPANY has just closed a contract through its New York sales agent, Mr. W. L. Lawton, 17 Battery Place, for ten elevators for the new factory building of Eaton, Cole & Burnham Co., of Bridgeport, Conn.

SOME C & C CONTRACTS.—The C & C Electric Company reports receipt of a large number of contracts, principally for large sized generators and motors, from various parts of the country. The Brooklyn Cooperage Company has ordered a 75-kw, also a 60-kw. C & C generator for direct connection to 110-hp and 90-hp engines, to be built by the Ames Iron Works, Oswego, N. Y. The order also calls for three C & C motors, aggregating 100-hp capacity. The equipment will be used for both light and power. The Otsego Hotel Company, which is to build a large hotel in Jackson, Mich., has requisitioned for two 50-kw. generators for direct connection to 12 in. by 12 in. Ames engines. This outfit will be used for lighting purposes. Colonel H. A. Dupont, of Wilmington, Del., has ordered a 225-kw. belted generator for lighting and power use in a new Chicago factory building. The Reeves Engine Company, of Trenton, N. J., has sent in an order for a 75-kw. generator for direct connection to one of its own engines. This outfit will be installed in the Trenton Fire Clay & Porcelain Works for light and power purposes. The Miller Lock Company, of Frankford, Pa., has ordered a 50-kw. belted generator and a 40-hp motor for light and power use. The Rogers Locomotive Works, Paterson, N. J., have just sent in the third order for a 150-kw. direct connected generator to be used for power purposes. Seven motors, varying from 7.5 hp to 50-hp capacity each, have been ordered for installation in the new Hotel Belmont, Forty-second Street and Park Avenue, New York. They will be used for driving, heating and ventilating, the apparatus being furnished by Howard & Morse and the B. F. Sturtevant Co. The Continental Mills, at Lewiston, Me., will be equipped with four C & C belted generators of 55-kw capacity each, for light and power use. The Illinois Sewing Machine Company, of Rockford, Ill., has ordered a 150-kw. generator, which will be driven by a 225-hp engine of Corliss type manufactured at the Murray Iron Works, of Burlington, Ia. This equipment will be used for both light and power. The Salisbury Light, Heat & Power Company, of Salisbury, Md., has ordered a 100-kw. belted dynamo for installation in an extension to its plant.

AMERICANS TO BUILD ELECTRIC RAILWAY ACROSS NICARAGUA.—An American syndicate has been formed for the purpose of building an electric railway system right across Nicaragua, Central America. Pittsburgers are primarily interested in the project. T. M. Latimer, president of the Lindmore Land Company, and the Anglo-American Potteries Company, of Pittsburg, is the chief party concerned in the enterprise. Others largely interested are Isham Sedgwick, of the United Coffee Company, and C. T. Manning, who is the Nicaraguan representative of R. G. Dun & Co. The Nicaraguan steam railroad, which was built about a year ago by British capitalists, and is now owned and operated by the Nicaraguan Government, will be acquired by the syndicate. The line runs from Port of Corinto on the Pacific Ocean to Granada on the Lake of Nicaragua via Chinandega. Its length is 161 miles. The road will be electrically converted, and is to be operated in connection with a new electric road, which will join the existing one at Managua and extend to the Atlantic Ocean, having terminals at Monkey Point and Perlas. The third-rail system will be employed. The present Nicaragua road is narrow gauge. It will be standardized as well as the new line. The length of the system will be about 500 miles. The power house will be constructed at Matagalpa, where there is an abundance of water power available. The new system will be constructed, it is anticipated, at the rate of about 100 miles per annum, so that it will take about 5 years to complete. Each section will be placed in service as soon as finished. Branch lines are proposed to be built so as to connect with roads in Honduras and Costa Rica.

CARS FOR PERU, BRAZIL AND PORTO RICO.—The John Stephenson Company, of Elizabeth, N. J., and the Peckham Manufacturing Company, New York, have just secured another contract for car bodies and trucks for use on the electric traction system now being built under the supervision of A. W. McLimont on behalf of the General Electric Company, between Lima and Callao. The present contract calls for four ten-bench open cars. The trucks will be of the four-wheel type. The G. E. motors will be of 35-hp capacity each. The Tijuca Electric Railway Company, Brazil, has ordered two Peckham trucks to be fitted with G. E. motors of 38 hp each. The company is increasing its rolling stock. The car bodies will be built in Brazil. No additional power house equipment will be purchased at present. The San Juan Light & Transit Company, which is controlled by the electrical engineering and contracting firm of J. G. White & Co., has requisitioned for three pairs of Peckham maximum trucks, equipped with G. E. motors of 50-hp capacity each, for use on its electric traction system at San Juan, Porto Rico.

THE PLATTE RIVER CANAL POWER TRANSMISSION PROJECT IN NEBRASKA.—Messrs. J. F. Kelly, T. W. Kloman and C. B. Vance, of New York City; W. J. C. Kenyon, general manager, and W. S. King, chief engineer, of the South Omaha Stock Yards Company; L. D. Richards, of Fremont, and H. E. Babcock, of Columbus, have been going over the plans and routes of the power transmission project for the development of electric power from the Platte River, for transmission to Omaha and intervening points. Two separate schemes are under consideration, the site of one being near Fremont, Neb., and the other near Columbus, Neb. It is understood that capitalists interested in the packing house industries have taken up the project and the John F. Kelly Engineering Company, of New York City, has been called upon to go over the plans already drawn up by the local engineers and to decide upon the more feasible of the two and make careful estimates of the costs. Upon the decision of the experts will depend the selection of the route and the practicability of the scheme determined. Should the experts report favorably on either proposition, it is said there will be no trouble in securing funds to finance the deal. Local parties estimate the probable cost as about $3,000,000.

VARIOUS EQUIPMENTS FOR PHILADELPHIA.—The electrical engineering and contracting firm of Keller, Pike & Co., Philadelphia, Pa., has just placed an order for the lighting equipment to be installed in the University of Pennsylvania gymnasium, Philadelphia. It will consist of two 50-kw. C & C dynamos, direct connected to 75-hp Harrisburg engines. Francis Brothers & Jellett, general electrical contractors, of Philadelphia, have placed orders for the generators to be installed in the new Mint, Realty Building and the Majestic Building, Philadelphia. Two 75-kw. C & C machines will be put in the former building, and two 75-kw. and one 50-kw. generators will go in the Majestic. The Hotel Vendig is to have a 50-kw. C & C generator direct connected to a Harrisburg engine of standard type and 12 in. by 11 in. dimensions.

HARRISBURG ENGINE ORDERS.—Mackenzie, Quarrier & Ferguson, 120 Liberty Street, New York, which concern represents the Harrisburg Foundry & Machine Works, has secured a contract from the Domestic Sewing Machine Company, of Newark, N. J., for a 150-hp Harrisburg standard engine for direct connection to a 100-kw. Westinghouse generator. The equipment is intended for lighting purposes. The Rogers Locomotive Works, of Paterson, N. J., have ordered a 225-hp engine for direct connection to a 150-kw. generator of C & C build. The West Point Naval Academy has requisitioned for a 75-hp Ideal engine, to be direct connected for lighting use to a Westinghouse generator. The Harrisburg people have now over 60 engines of various sizes under construction at their works.

TRANSMISSION IN OHIO.—The Noblesville Hydraulic Company, Noblesville, Ind., has awarded the contract to the Leffler Wheel Company, of Springfield, Ohio, for six 50-in. turbine wheels for $14,500; and to the National Electric Company, of New York, for the generators and dynamos for $18,500. The company is constructing an electric light and power plant a few miles north of the city and proposes operating it by water power from White River. It is estimated that each turbine wheel will generate 350 hp, thus furnishing over 2,000 hp for transmission to the city. A dam 17 ft. high is nearing completion.

ELECTRICAL EQUIPMENT FOR OHIO QUARRIES.—An extensive electrical equipment is to be installed for the purpose of operating all the machinery, etc., at the Ohio Quarries Company's quarries at North Amherst, O. Two 200-kw. generators have been ordered from the C & C Electric Company for direct connection to 300-hp. engines to be built by A. L. Ide & Sons, Springfield, Ill. A 35-hp C & C motor-dynamo set has been ordered, also three 60-hp C & C motors and a similar number of 12-hp machines will be installed.

EQUIPMENT FOR NEW B. & O. SHOPS.—The new shops of the Baltimore & Ohio Railroad, now under construction at Greenwood, Pa., are to be electrically equipped. The contract for the boilers—1,000 hp in four units of 250-hp each—has been given to Thayer & Co., 39-41 Cortlandt Street, New York. They will be built by the Aultman & Taylor Machinery Company, of Mansfield, O.

ELECTRIC HOISTS FOR HAMBURG-AMERICAN DOCKS.—Several electrically operated hoisting equipments are to be installed in the new American docks, Hoboken, N. J. So far six hoists have been ordered from the Consolidated Iron Works, Hoboken. They will be operated by C & C motors of 35-hp capacity each.

TWO HUNDRED CARS FOR B. R. T.—The Brooklyn Rapid Transit Company has just ordered 200 special M. C. B. trucks from the Peckham Manufacturing Company, 26 Cortlandt Street, New York, for elevated service. They will be equipped with Westinghouse motors.

THE IRON CITY ENGINEERING COMPANY, Pittsburg, Pa., has secured a contract for the entire electrical equipment, including pole line work, for the town of Rockwood, Pa.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. Next meeting Niagara Falls, N. Y., Sept. 17, 18 and 19, 1903.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, Atlantic City, N. J., September 22, 23 and 24, 1903.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York.

AMERICAN ORDER OF STEAM ENGINEERS. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Ave., Detroit, Mich.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Thousand Islands, N. Y., September 8, 9 and 10, 1903.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, Indianapolis, Ind., June 15, 1904.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, F. P. Ide, Springfield, Ill. Next meeting, December, 1903. Date and place to be announced later.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, Ill., December 8, 9 and 10, 1903.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Des Moines, Ia. Annual meeting, Des Moines, March 8, 1904.

MAGNETIC CLUB, New York, N. Y. Secretary, R. J. Murphy, 195 Broadway, New York City. Annual meeting, Second Thursday in January; meetings, April, June and November.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting St. Louis, Mo., September 14, 15 and 16, 1904.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, J. H. Neal, Boston, Mass. Meetings, Fourth Thursday of each month, July and August excepted.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May or June, 1904.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, Wis., Jan. 20, 1904.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, J. H. Perkins, Youngstown, Ohio. Next meeting, Columbus, Ohio, October 13, 14 and 15, 1903.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION AND SOCIETY OF UNITED STATES MILITARY CORPS. Secretary, John Brant, 195 Broadway, New York. Next meeting, Milwaukee, Wis., September 23, 24 and 25, 1903.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa. Next meeting, Williamsport, Pa., September 23, 1903.

SOUTHERN INDIANA TELEPHONE ASSOCIATION. Secretary, E. W. Pichardt, Huntingburg, Ind.

SOUTHWESTERN ELECTRICAL ASSOCIATION. Secretary, G. W. Cooper, Oklahoma City, Okla. First Semi-Annual meeting, Oklahoma City, October 9 and 10, 1903.

SOUTHWESTERN GAS, ELECTRIC & STREET RAILWAY ASSOCIATION. Secretary, Frank E. Scovill, Austin, Texas.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, Henry A. Robinson, 621 Broadway, New York. Next meeting, Syracuse, N. Y., October 6 and 7, 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

UNITED ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, William J. Davis, Ithaca, N. Y. Next meeting, New York City, January, 1904.

General News.

THE TELEPHONE.

HUNTSVILLE, ALA.—The Huntsville & Guntersville Telephone Company will build a 16-mile extension. The American Telephone Company will also build an extension to New Market.

WOODLAND, CAL.—A new telephone line is to be built from Winters which will connect with the farmers' lines at Madison, Woodland and Sacramento and private lines at Arbuckle and Colusa.

DOVER, DEL.—A charter has been granted to the William Ebbitts Electric Company, with a capital stock of $150,000, to own telephone lines and telephone appliances and other devices. The company is from Cleveland, Ohio.

ATHENS, GA.—The Adams Telephone system of Stewart County, Ga., has extended to Columbus.

DUBLIN, GA.—The Dublin telephone exchange and the long distance telephone lines, including the lines to Sandersville, Wrightsville, Tennille and Kittrell, the line to Adrian and the line to Macon and Dexter have been purchased by the Dublin Telephone Company, which is composed principally of Messrs. Malcom D. Jones, of Macon, and F. F. Scarborough, of Dublin.

SAVANNAH, GA.—A charter has been applied for the Southern Long Distance Telegraph & Telephone Company. The application states that the purposes of the new company are to build and operate telegraph and telephone lines within the State of Georgia, and the proposed capital stock is placed at $100,000, with privilege of increasing to $1,000,000. The incorporators are J. H. Estill, W. A. Bisbee, Herman Myers, H. P. Smart, J. Paulsen, Leopold Adler, W. W. Gordon, Jr., and John Flannery.

MOWEAGUE, ILL.—Harry Odell and A. C. Doty have purchased the Odell telephone plant as equal partners, Oscar Odell retiring from the business.

SHELBYVILLE, ILL.—The Queen City & Shelby County Mutual Telephone Company has been formed, capital $10,000. Incorporators: J. F. Ulmer, S. A. Richardson, J. H. Thomas.

WAUKEGAN, ILL.—Mr. Chauncey G. Hellick is preparing plans for a fireproof telephonic exchange to be built at Waukegan for the Chicago Telephone Company. It will cost $20,000.

FREEPORT, ILL.—The New Telephone Company announces the completion of a line from Freeport to Lena, connecting with the Pearl City independent lines and various towns on that system.

BRADFORD, ILL.—The Milo & Bradford Telephone Company has increased its capital stock from $5,000 to $20,000. The increase was voted at a special meeting of the stockholders, for the purpose of expansion.

GALESBURG, ILL.—The Ideal telephone exchange, which was completed less than two years ago, has grown and now operates nearly 50 miles of wires. There are now 135 shares of stock and the same number of subscribers.

MONMOUTH, ILL.—The annual meeting of the Monmouth Telephone Company has been held and by the report the recepits for the past year were shown to be $10,833.74, and the expenditures within this amount. Among the items of expenses is one of $3,306.34, for the extension of the system.

FOWLERTON, IND.—The Bell Telephone Company is putting in a new switchboard here.

PLEASANT LAKE, IND.—The Farmers' Telephone Company is putting up a metallic line from Angola to this place, also to Hamilton.

FORT WAYNE, IND.—The National Telephone Company, of which the Home Company of this city is a part, is building a new copper line that will give through connection from Fort Wayne to Indianapolis.

INDIANAPOLIS, IND.—The Fisher Telephone Company, of Hamilton County, has been incorporated for $5,000. The directors are T. A. Fisher, Thomas A. Beaver, J. A. Noury, N. G. Manship and A. C. Harrison.

INDIANAPOLIS, IND.—The Swayzee Co-operative Telephone Company has been formed, capital stock $6,000, by Eugene T. Ireland, Harrison Mark, Z. Hambler, Clement I. Goble, Rue P. Henley, William H. Ammon and C. C. Pence.

LOGANSPORT, IND.—The Home Telephone Company and the Case County Telephone Construction Company have effected a reorganization of the company, which is now composed solely of Logansport men. The Fort Wayne parties have sold their interests. The capital stock has been increased to $350,000.

CHICKASHA, I. T.—The new telephone system inaugurated by the Topeka & El Reno Telephone Company has commenced operations. Since this company purchased the local exchange it has expended over $5,000 in overhauling and changing and the system has been practically renewed throughout.

OGDEN, IA.—The town has voted to grant a franchise for a telephone exchange.

TORONTO, IA.—The Clarence Telephone Company will build a line southwest from here.

MUSCATINE, IA.—The Muscatine Telephone Company has been formed. Capital $1,200.

OTLEY, IA.—The Otley Telephone Company has been incorporated with a capital of $5,000.

BURLINGTON, IA.—The Modern Telephone Company, of Burlington, has incorporated; capital $300,000.

DES MOINES, IA.—The Butler County Telephone Company has been incorporated with $10,000 capital.

DES MOINES, IA.—The West Liberty Telephone Company has increased its capital from $10,000 to $25,000.

RUTHVEN, IA.—The Ruthven Telephone Exchange Company has been incorporated with $20,000 capital stock.

OTTUMWA, IA.—The Iowa Telephone Company has a site for the erection of a modern central exchange building.

CHARTER OAK, IA.—The Crawford County Telephone Company will establish a first-class local and long distance system.

DES MOINES, IA.—The Mutual Telephone Company will arrange to expend $100,000 to $150,000 in improvements to its system.

ALGONA, IA.—The Burt Telephone Company has recently added three short rural lines to its system. Its patrons now number 149.

DES MOINES, IA.—From West Point, the German-American Telephone Company will build lines to Lowell, Montrose and Fort Madison.

SHELBY, IA.—Amended articles of the Shelby Independent Telephone Company have been filed, increasing the stock from $10,000 to $25,000.

WATERLOO, IA.—The council has granted the desired franchise for the Iowa Telephone Company which will proceed to rebuild its local system.

MUSCATINE, IA.—Plans have been prepared by H. W. Zeidler, architect, for a building for the Iowa Telephone Company, which will cost $6,000.

DAVENPORT, IA.—The capital of the New Independent Telephone Company has been increased to $150,000. Extensive improvements will be made and the line may be extended to St. Louis.

IOWA CITY, IA.—Manager A. J. Presson, of the Johnson County Telephone Company, is interested in a $500,000 transaction. The money must be secured by the Cedar Valley Telephone Company for the prosecution of various improvements, to be contemplated by the big organization.

DODGE CITY, KAN.—The Dodge City Telephone Company is extending its line.

ATCHISON, KAN.—Theodore Gary has purchased a controlling interest in the exchange at Atchison, Kan. The Atchison exchange has 1100 telephones now in use. The company, of which Mr. Gary is president, will spend $25,000 in improving and extending the service within the next four months.

COVINGTON, KY.—Bids have been advertised for the sale of a franchise for the construction of a telephone and messenger system in the city of Covington, the franchise to run for twenty years.

FRANKFORT, KY.—The Independence Telephone Company, of Kenton County, with $5,000 capital, has filed incorporation articles with the Secretary of State. John M. Chambers, W. T. Loomis, Alvin Perry, C. M. Perry and John L. Vest are the incorporators.

PORTLAND, ME.—The Cumberland Telephone Company has been organized at Portland for operating telephones and telegraph lines; capital stock $50,000; paid in, $500. President, M. H. Kelley, Saco, Me.; treasurer, Alex Speirs, Westbrook, Me.

SWAN'S ISLAND, ME.—The Swan's Island Telephone & Telegraph Company has been formed for constructing and operating telephone and telegraph lines. Capital $5,000, of which $350 is paid in. President, W. B. Lindsay; treasurer, A. C. Smith. Directors: W. B. Lindsay, Carlisle, Pa.; A. C. Smith, Swan's Island; H. W. Joyce, I. W. Stinson, L. E. Joyce and H. W. Small, of Swan's Island, Me.

PORTLAND, ME.—The United States government is to connect all of its forts by telephone and work has been commenced on the system which will be an extensive one, as well as a very expensive piece of work. Fort Leavitt, on Cushing's island, Fort Preble, at South Portland, Fort Williams, at Portland Head, and Fort McKinley, on Great Diamond island, will be joined by private wires, having no connection whatever with the New England Telephone & Telegraph Company's system which has just been installed on Peaks and Great Diamond islands.

ELKTON, MD.—The Diamond State Telephone Company has built a line from Port Deposit to Conowingo. It will connect with the lines of Harford and Lancaster counties.

CAMDEN, MICH.—The Camden Telephone Company has started its exchange with a large number of local and rural subscribers. Lines are being built in every direction and will soon connect the northern towns of this county with the Ohio and Indiana lines.

SCHOOLCRAFT, MICH.—The stockholders of the Schoolcraft Telephone Company, at a meeting held for the purpose of perfecting the organization, elected a board of directors as follows: C. C. Duncan, John Gilchrist, B. J. Munn, W. R. Blodgett, F. M. Smith, C. W. Krum and R. E. Burney.

PARK RAPIDS, MINN.—The Union Telephone Company will build an exchange here.

DAYTON, MINN.—The Northwestern Telephone Company will build a line from here to Itasca and connect with Anoka.

NORTHFIELD, MINN.—The American Telephone & Telegraph Company has been permitted to run its lines into the city.

MORGAN, MINN.—The Redwood County Rural Telephone Company will build a line north connecting with the Franklin line.

VALLEY CITY, MINN.—A new telephone exchange with forty subscribers has been installed here by Ora Beeman. Connection is made with the Northwestern long distance service.

FOLEY, MINN.—The Maple Leaf Telephone Company has been granted a franchise for a local exchange. It will connect with the Northwestern long distance line running from St. Cloud to Foley.

RAPIDAN, MINN.—A meeting of several of the farmers of Rapidan has been held for the purpose of forming a local telephone company to connect with the Northwestern line of this city. C. A. Cheney was elected president, Wm. Jamieson, treasurer, and Chas. Johnson, secretary.

BUTTE, MONT.—The Rocky Mountain Bell Telephone Company has completed the purchase of the lines and exchanges of the Montana & Wyoming Telephone Company in Wyoming, extending from Cody to Meeteetse and Basin. Negotiations are on for the purchase of lines in Montana embracing Red Lodge and Billings points. The new lines of the Bell people will enable one to talk from Butte or Salt Lake to Cheyenne and Denver.

FREMONT, NEB.—The Nebraska Telephone Company will spend about $10,000 in improving its plant at Fremont. It will put in a board with 1,000 drops, among the new improvements.

NORFOLK, NEB.—The Elkhorn Valley Telephone Company has filed articles of incorporation, the principal place of business being at Norfolk. The incorporators are I. S. Mahan, G. B. Christoph, and G. A. Luikhart. The capital stock is $100,000.

LINCOLN, NEB.—Articles of incorporation of the Virginia Telephone Company, Gage County, have been filed at Lincoln by the incorporators, Messrs. John A. Dobbs, William Holm, W. H. Stambaugh, Joel Dobbs, W. J. Kiser, Joseph Mangus and J. A. Erickson. The capital stock is given as $4,000.

VERDIGREE, NEB.—Mr. Emil Shiem, president; Mr. J. B. Bates, vice-president, and Mr. B. Stevenson, secretary and treasurer, are the officers of the Verdigree Telephone Company, which has been organized, with a capital of $1,000, for operating a telephone line between Verdigree, Armstrong and Pischelville, Neb.

FREMONT, NEB.—On the morning of August 17 linemen of the Nebraska Telephone Company (the Bell company) cut the wires connecting the Farmers' and the Hooper exchanges. This action of the Nebraska Company was taken to enforce its contract with the Farmers' system, which prohibits the latter from connecting with exchanges other than those of the Bell company. Four wires running southwest from Hooper were cut.

OMAHA, NEB.—The York County Independent Telephone Company has connected lines with the Filmore County Independent Company, and also with the independent lines at Beaver Crossing, Milford and Friend, Neb. The local independent company at York has also built east to Utica, where it expects to connect with independent lines giving connection with Lincoln. North it has built into Stromsburg, where it is connected with the local independent company, and in a short time will have connection as far East as South Omaha.

TRENTON, N. J.—At an expense of nearly $50,000 the Fire Committee of Common Council is placing the wires of Trenton's police and fire-alarm system in underground conduits, hoping thereby to overcome frequent interruption to the service by reason of storms and other unfavorable conditions.

HAMMONTON, N. J.—The officials of the Interstate Telephone Company are securing the right of way through Hammonton to erect their trunk lines from Atlantic City to this place, where they will connect with the Eastern Telephone Company, which will rebuild from Camden to this point. The former company has secured from the Board of Freeholders of Atlantic County a franchise to build lines throughout Atlantic County, while the Eastern Company has similar privilege through Camden County. This will give long distance telephone service between Atlantic City and Philadelphia, in opposition to the Bell Company.

SYRACUSE, N. Y.—The Syracuse Telephone Company is considering the expenditure of $300,000 in the improvement of its system in this city.

MILFORD, N. Y.—The Westville Telephone Company has been incorporated with a capital stock of $1,000, to build and operate a line from this village to South Valley. Directors: Frank Green, J. M. Cady, E. B. Coats and others.

SODUS, N. Y.—The Empire State Telephone Company has decided to develop its system in this section. For the benefit of Rochester, Williamson, Sodus and Wolcott patrons a direct line of two copper wires is being installed. Williamson will be connected with the summer resort at Sodus Bay by two wires, and several wires will be run from Clyde to North Rose and then west and south to Palmyra. Another line of wires will run to North Rose from Clyde and then east to Wolcott.

AMITYVILLE, N. Y.—Articles incorporating the Suffolk County Telephone Company have been filed to carry on operations in the County of Suffolk, its lines extending along Main or the South Country road, from Amityville on the west to Montauk on the east, connecting all the intermediate villages on the south side of Long Island. The capital stock is $3,500, and the directors for the first year are H. Clay Losee, Walter H. Jaycox, Fremont Hammond and Joseph T. Losee, of Patchogue; Ralph C. Greene, of Sayville, and Morris F. Tyler, of East Patchogue.

CLINTON, N. C.—The Clinton & Garland Telephone Company has been chartered.

EDMORE, N. D.—The Northwestern Telephone Company is busy putting a system and exchange in Edmore.

WAPAKONETA, OHIO.—The St. Marys Telephone Company will install an automatic telephone system in its new plant.

CLEVELAND, OHIO.—The Telephone Directory Company, capital $10,000, has been formed by W. H. H. Gorham, H. C. Brainerd, C. S. Bentley, F. L. Wait and C. H. Taylor.

CLYDE, OHIO.—The Farmers Telephone Company has been formed, capital $10,000, by F. S. Bronson, Fred Hutchison, Samuel Decker, S. F. Royer, D. H. Good and C. C. Wright.

SPRINGFIELD, OHIO.—Superintendent Gunn announces that the entire Appleyard system of traction lines is to be equipped with a Bell telephone system. The exchange will be located in this city.

JOHNSTOWN, OHIO.—The Johnstown & Croton Telephone Company with headquarters at Johnstown, Licking County, has filed a certificate with the secretary of state, increasing its capital stock from $30,000 to $50,000. Frank L. Beam is the president and Dwight E. Sapp is secretary of the company.

WAPAKONETA, OHIO.—The Buckland Telephone Company has been organized with the following officers and directors: President, H. D. Bowsher; secretary, T. B. Bowsher; vice-president, Dr. R. W. Sharp. Directors: Beecher Graham, John Edman, G. W. Romshe, S. A. Brookhart, Clarence Lathrop and Charles F. Bowsher.

OTTAWA, ONT.—The Bell Telephone Company has submitted to the city of Hamilton, Ont., a proposition for the exclusive franchise for the next five years, which will likely be accepted. The company's proposal is to pay the city $2,900 a year; give the city 125 telephones at a cost of $25 each, and look after the police call system. The rate for private telephones will be $30 a year unlimited, and $25 for a measured service.

WYOMING, PA.—The franchises and all privileges of the Wyoming Telephone Company have been bought by J. Wood Piatt.

LANGFORD, S. D.—The local telephone exchange will extend rural lines through the county.

ESTELLINE, S. D.—The Estelline Telephone Company has been incorporated with a capital of $10,000.

EGAN, S. D.—The Farmers' Egan Telephone Company has been incorporated with a capital stock of $10,000.

DELL RAPIDS, S. D.—The Dell Rapids Telephone Company is selling $5,000 worth of stock and will build rural lines.

LEAD, S. D.—The Nebraska Telephone Company, owner of the Black Hills system of telephones, has been granted a franchise by the city council of Lead to establish a central office, and is preparing to install a $25,000 plant here.

MEMPHIS, TENN.—The Mutual Telephone Company, has been formed and domiciled at Walnut Grove, capital stock, $100,000. The object of this company is to build a line from Forest to Carthage.

CHATTANOOGA, TENN.—It is announced that the Cumberland Telephone Company will soon begin the use of its wires for telegraph service between Chattanooga and Asheville, N. C. This, it is said, is done in order to compete with the Western Union Telegraph Company for the Chattanooga-Asheville business.

CHATTANOOGA, TENN.—The Hamilton Telephone Company is a new organization at Chattanooga growing out of the report that the Cumberland Telephone Company would raise its rates. The new concern has been granted a franchise by both branches of the City Council and the franchise referred to the proper committees. It is stipulated that rates shall not exceed $24 for residences and $36 for business houses. The rates which it is said the Cumberland Company will put into operation, are $30 and $48.

GAINESVILLE, TEX.—The People's Home Telephone Company has been incorporated with a capital stock of $250,000. Directors: F. B. McElroy and others.

OGDEN, UTAH.—The Utah Independent Home Telephone Company will erect a two-story telephone exchange. This is one of the preliminary steps to the installation of the new system.

SALT LAKE CITY, UTAH.—The Utah Independent Telephone Company has a large force of men at work on its underground conduits and placing poles in various parts of the city. The company has also taken out a building permit for the construction of a telephone building, which will cost $45,000. This will put a quietus on the report that the company was not securing a franchise in good faith.

RICHMOND, VA.—The corporation commission has granted a charter to the Mecklenberg Telephone Company, of Mecklenberg County, capital $250 to $5,000. The incorporators are W. H. Elam, Jr., C. F. Currin, J. O. D. Gohlson, F. W. Currin, W. A. Elam, R. F. Elam, S. W. Sand and J. D. Elam.

ROBERTS, WIS.—A telephone company has been formed to install a local exchange. R. C. Andrus is secretary.

LA CROSSE, WIS.—The La Crosse Telephone Company expects to install from 500 to 1,000 farmers' telephones in this county.

MILWAUKEE, WIS.—The Interstate Telephone Company has been incorporated with a capital stock of $4,000. J. A. Hull is agent.

UNION GROVE, WIS.—The North Cape Telephone Company has a gang of men extending its line into the Scotch settlement and Ives' Grove.

KNAPP, WIS.—The Knapp Telephone Company has been incorporated with a capital stock of $5,000. Directors: C. A. Silkworth and others.

ASHLAND, WIS.—The Bayfield County Telephone Company has been incorporated with a capital stock of $30,000. Directors: C. F. Latimer and others.

RIVER FALLS, WIS.—The St. Croix Valley Telephone Company has been formed, capital stock $1,200. Incorporators: J. L. Chapman, J. A. Chinnock, J. Bailey.

BORRE, WIS.—The Borre Mills Telephone Company has been incorporated, capital stock $30,000. Incorporators: George D. Sprain, W. C. Miller, August Nuttleman and others.

MADISON, WIS.—The Eau Claire County Telephone Company has been incorporated, capital stock $5,000, divided into 100 shares of $50 each. Incorporators: C. A. Silkworth, J. J. Osborn and Marshall Cousins.

MILWAUKEE, WIS.—The Stoughton Independent Telephone Company has been formed, capital stock $45,000, divided into 2,250 shares of $20 each. Incorporators: Robert R. Freeman, Clarence S. Pierce and William G. Whitehead.

READSTOWN, WIS.—The Readstown Telephone Company is making numerous improvements to its line. The company is at work on the extension to De Soto and as soon as that is completed will run its line to Sylvan, put a branch up the Harrison Hollow and a double wire to Brookville.

ELECTRIC LIGHT AND POWER.

HARRISBURG, ARK.—The Board of Alderman has granted G. F. Garvey a franchise for an electric light plant.

TUSCALOOSA, ALA.—The plant of the Tuscaloosa Light & Power Company was recently destroyed by the explosion of a 100-hp boiler. The loss is estimated at $20,000.

SAN FRANCISCO, CAL.—The California Power & Development Company of Central California, has been incorporated, with a capital of $2,000,000. Directors: K. H. Plate, of San Jose; I. Meyer, of Lincoln; J. I. Hohn, of Oakland, and others.

SAN LUIS OBISPO, CAL.—The San Luis Gas & Electric Company will expend about $100,000 in improvements to include new building, engine, boilers, generator, transformers and new gas plant complete. W. F. Boardman, 530 Market Street, San Francisco, is president.

SAN FRANCISCO, CAL.—The Owens River Water & Power Company is planning the construction of an electric power transmission system between its plant and Tonopah, Nev., a distance of 90 miles. A meeting of the stockholders will be held on October 12 to vote on a proposed bond issue of $2,500,000.

ARVADA, COLO.—Wm. Rawlins is president of a company organized to construct an electric light plant and street car system.

BLUERIDGE, GA.—It is reported that the Blueridge Electric Light & Power Company will purchase additional machinery. H. P. Mackey is secretary.

STERLING, ILL.—Robt. Miller, engineer of the Sterling Gas & Electric Light Company has completed plans and specifications for the new electric light station to be erected on the site of the old plant, to cost about $50,000. The plans and specifications for the new hydraulic plant have also been completed.

NEW HAVEN, IND.—The Council is figuring on the cost of an electric light plant.

RIVERSIDE, IND.—The Town Council has granted the Muncie Electric Light Company, of Muncie, an electric light franchise.

RICHMOND, IND.—The Light, Heat & Power Company will make an addition to its plant, to cost $40,000. J. W. Roney is general manager.

MUNCIE, IND.—The Union Trust Company, of Indianapolis, has acknowledged the release of a $60,000 mortgage held on the property of the Muncie Electric Light, Heat & Power Company. The amount has been paid in full.

VINCENNES, IND.—Smiley M. Chambers, who is heading a syndicate of Eastern and Indianapolis capitalists for the promotion and construction of an electric road from Vincennes to Jasper, has purchased the Vincennes electric light and gas plants.

FT. WAYNE, IND.—The Common Council is obtaining estimates on a station to furnish current for 600 to 800 arc lights and 35,000 to 50,000 incandescent lamps. No engineer has been retained. City Clerk A. M. Schmidt can furnish further information.

CRAWFORDSVILLE, IND.—The City Council has elected an electric light board to take charge of the municipal electric light plant. This step is taken to avoid, if possible, further financial loss. The previous management of the electric light plant by the city has been disappointing. The report for July gave the grand total expenses as $2,081.17 and the grand total receipts as $1,918.43, leaving a deficit of $163.28. The cost of the 143 street lights for the month was $878.28, or $6.14 each. This is at the rate of $73.70 per year.

INDIAN ORCHARD, MASS.—The United Electric Light Company is to build an extension to its plant at Indian Orchard.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company has petitioned the Gas & Electric Light Commissioners for authority to issue $140,000 bonds to build a dam, head gates, canal, power house, etc.

OCATLAN, MEX.—An electric light and power plant is to be established here.

TEZUITLAN, MEX.—It is stated that the electric power plant of the Tezuitlan Copper Company at this place is to be enlarged. The plant now has two units of a total of 666 horse power and it is proposed to install another unit to increase the capacity to 1,000 horse power. The power is generated by a waterfall obtained by the construction of 3,600 feet of ditch.

ADRIAN, MICH.—The Citizens' Electric Light, Power Company, capital $100,000, has been formed at Adrian, to take over the old company.

FLINT, MICH.—The Flint Light & Power Company has organized here by electing officers. D. G. Wright, of Philadelphia, Pa., is president, and Arthur G. Bishop, of this city, secretary and treasurer. The new company takes over the plant of the People's Electric Light Company. Eastern capitalists are interested in the new corporation, and the capital stock of the old organization will be increased to $150,000.

GLENWOOD, MINN.—The Glenwood Mill & Electric Company has been formed to consolidate the mill and light plants. The light plant will be rebuilt.

SOUTH STILLWATER, MINN.—Bids are being received for an electric light plant and water works, according to plans prepared by J. J. Flather, engineer, Minneapolis, Minn. Mr. Fred Kroeger is the village recorder.

SENATOBIA, MISS.—Harper Johnson, Mayor, writes that bids for material for an electric light plant are wanted at once. The probable cost of the plant is $6,000.

MARSHALL, MO.—The City of Marshall has bought the Marshall waterworks for $40,000. New city waterworks and an electric light plant will be built.

DILLON, MONT.—Articles have been filed by the Greater Electric Company to construct electric light and power lines and telegraph and telephone lines at Dillon; capital $40,000. A. F. Graeter and Wm. Roe, of Dillon, and Jos. Shineberger, of Redrock, are trustees.

VIRGINIA CITY, NEB.—Electric power is to be placed in the mines at Bodie, Nev., by Capt. Warren Loose, of Salt Lake. The plant will be installed on Rush Creek, and will generate 30,000 horse power.

LINCOLN, NEB.—As the result of an action taken by the City Council gas will be substituted for electric light in many of the city streets, with the exception of a few of the most important streets, where the electric lights will be retained. The change from electric light to gas is the result of an agitation on the part of some who were dissatisfied with the electric lighting service. The gas and electric light plants are both owned by the same company. A storm of protest from the citizens has been aroused by what those most interested consider a step backward.

NIAGARA FALLS, N. Y.—The Buffalo & Niagara Falls Electric Light & Power Company has secured the contract for furnishing 400 electric arc lights of 2,000 cp. each at $65 per year all night and every night.

ALBANY, N. Y.—The Granville Electric & Gas Company, of Granville, Washington County, has been incorporated; capital, $150,000. Directors: F. T. Pember and E. R. Norton, Granville; N. T. Drake, Sandy Hill.

GENEVA, N. Y.—It is stated that a syndicate is being formed in Geneva for the purpose of combining the electric lighting plants of Geneva, Waterloo, Seneca Falls, Clyde, Lyons, Newark and Palmyra. It is believed the capital will be about $1,000,000.

HOOSICK FALLS, N. Y.—The Hoosac River Electric Light & Power Company has been incorporated with a capital of $50,000, to operate in Schaghticoke, Valley Falls, Johnsonville, Eagle Bridge, Hoosick, Hoosick Falls, Cambridge, Green Island, Waterford, Albany, Cohoes, Rensselaer, Troy, Waterford and the towns of Schaghticoke, Pittstown, Hoosick, White Creek, Cambridge, Jackson, Easton, Greenwich and Petersburg. Directors: Le Grand C. Tibbitts and George M. Bovie, of Hoosick, and Sayre McLeod, of Troy.

PICTOU, N. S.—F. Mackaracher, Town Clerk, writes that plans are being prepared by R. S. Kelsch, of Montreal, Que., for an electric light plant, to cost about $18,000.

NELSONVILLE, OHIO.—The citizens have voted to issue electric light bonds.

SANDUSKY, OHIO.—It is reported that the Sandusky Gas & Electric Company will expend about $100,000 in improvements.

SHERODSVILLE, OHIO.—The Sherodsville Electric Light Company, of Sherodsville, has been incorporated with a capital of $10,000.

YOUNGSTOWN, OHIO.—The Board of Public Service has been authorized to receive proposals on 250 incandescent lamps for lighting the city. A ten years' contract will be placed.

HILLSBORO, OHIO.—The present city lighting contract expired September 1, and proposals will be received for furnishing light. Several new people are desirous of securing the franchise and contract.

COLUMBUS, OHIO.—The lighting committee of the Board of Public Service has found that the plans laid out for the new municipal lighting plant will not be adequate for the requirements, and it is proposed to install another boiler, engine and generator.

HUBBARD, OHIO.—An electrical engineer employed by the council estimates that the electric light plant can be rebuilt for $4,000. The Youngstown & Sharon Street Railway Company has submitted a proposition to furnish light for the village. The matter will be settled in the near future.

OTTAWA, ONT.—Representatives of over a dozen municipalities in the province of Ontario recently met in Toronto in the interests of the scheme for the transmission of electric power from Niagara Falls to various municipalities. A commission was appointed to investigate the matter for the benefit of the municipalities interested, with the view to deciding on the desirability of undertaking such an enterprise, and also the probable cost. Electrical and financial experts will assist the commission.

OTTAWA, ONT.—A number of Montreal, Toronto and Halifax interests, through Mr. Q. E. Warwick, general manager of the street railway of the City of Mexico, have purchased the Pueblo Light & Power Company. The company, which at present supplies power to the city of Pueblo, about 72 miles from Mexico, was held by Mexican interests, and has an exclusive franchise from the government of Mexico. Like the Mexican Light & Power Company, a new corporation has secured from the Dominion government a charter with wide powers, as the Mexican government signified its willingness to give it the same rights as it would receive from the Dominion The capital of the Pueblo Company is authorized at $3,000,000, and Montreal is designated as the chief place of business. The incorporators are E. M. Edgar, L. L. Edgar, L. S. Colwell, John Pinder and Albert E. Warwick, all of Montreal.

SEASIDE, ORE.—The City Council has granted E. M. Crawford, of Portland, a franchise for an electric light plant.

WESTON, ORE.—The Weston Electric Light & Power Company is to construct an electric plant to cost about $90,000. The power plant will be located about 3 miles above Bingham Springs.

SHENANDOAH, PA.—A charter has been granted to the Peoples Electric Light, Heat & Power Company.

REDLION, PA.—George R. Heisey, of Marietta, and others, have purchased the plant for the Redlion Electric Light Company, and will make improvements.

JOHNSTOWN, PA.—The contract for furnishing 250 arc lamps for a period of five years, has been awarded to the Johnstown Electric Light Company of Johnstown, at $40 per lamp per year, 500 watts each.

PAWTUCKET, R. I.—The J. & P. Coates Thread Company has decided to abandon its power plant, throw out all its mammoth engines and boilers and enter into a contract with the Pawtucket Electric Company for a continuous service of 5,000 horse power for 20 years. To supply this power the electric company will build a new power plant provided it can secure a 20-year exclusive franchise from the city. The electric company joins with the Pawtucket Gas and Providence Telephone companies in requesting such franchises, under provisions of the State law, which admits of a municipal tax of three per cent. The new electric plant will cost $500,000, and with other projected extensions will ultimately develop into a million-dollar plant. The franchise plan involves a contract for lighting the city for 20 years. The Coates Thread Company is ready to contract with the Thomson-Houston Company for electrical machinery to transmit the power.

BISHOPVILLE, S. C.—An electric light plant, costing $10,000, will be built here.

ROCK HILL, S. C.—It is reported that the Catawba Electric Company, which is developing an immense water power near here, contemplates transmitting power to Charlotte, N. C., to be sold for manufacturing purposes.

CHERAW, S. C.—Contracts for the electric light plant have been awarded as follows: For construction, to the Standard Electric Company of Charlotte, N. C., $5,000, and for engines and boilers, to Gibbs & Company, Columbia, S. C., $1,772.

ANDERSON, S. C.—A syndicate has purchased a 6,600-hp water fall near Anderson and will develop the same electrically. J. J. Fretwell is among those interested. Some of the stockholders of the Anderson Water, Light & Power Company are interested in the new enterprise.

TRENTON, TENN.—The town of Trenton has defeated a bond proposition to purchase the local electric lighting plant.

BROWNSVILLE, TEX.—John W. Maxcy, of Houston, has secured a franchise from the city for water works, electric light plant and telephones.

PILOT POINT, TEX.—The Pilot Point Light & Power Company has been incorporated with a capital stock of $30,000. The incorporators are G. E. Light, A. H. Gee, F. W. Hayden and A. P. Crosgrove.

RICHMOND, VA.—The Merchants' Co-operative Light & Power Company will construct an electric light and power plant, at a cost of $500,000. Franchise has not as yet been secured.

RICHMOND, VA.—The Virginia Passenger & Power Company is reported to be concluding negotiations for the purchase of riparian rights for 30 miles on both sides of Appomattox River above Petersburg and the establishment of a power plant to generate 10,000-hp of electrical energy.

NORTON, VA.—The Cumberland Transportation Light & Power Company, of Norton, has been incorporated with a capital of $50,000 by Henry M. Smyth, R. W. Dickenson and others. The company will begin at once building an interurban electric railway from Norton to Tom's Creek via Wise, Glamorgan, Esserville and Dorchester to Norton, and from Norton via Big Stone Gap, Imboden, Blackwood, Osaka, Stonega and Minersville, connecting mining plants in Southwestern Virginia. Each of the towns will also have electric lights. The principal office will be at Norton.

IRON RIVER, WIS.—It is reported that the Iron River Water, Light & Power Company will construct a dam 36 feet high and 160 feet long to develop electric power.

THE ELECTRIC RAILWAY.

PETALUMA, CAL.—Bids will be received up to 7 o'clock p. m., Sept. 8, for a franchise to operate an electric railway on certain streets and highways within Petaluma as applied for by Burke Corbet.

SAN FRANCISCO, CAL.—The North Shore Railroad Company has opened its new third-rail road between Sausalito and Mill Valley, Cal. This is the first third-rail road in California. The interior of the cars is lighted by arc lights and the platforms by incandescents. The road will be extended to San Rafael within a month. Aluminum feeders are laid close to the third-rail, the working current being of 550 volts stepped down from the 40,000-volt current of the Bay Counties transmission. There is a reserve steam plant and a storage battery plant. The Babcock & Wilcox steam boilers are oil fired.

NEW LONDON, CONN.—The incorporators of the Groton & Stonington Street Railway Company have voted to accept the charter recently granted by the General Assembly. The capital stock of the company is fixed at $600,000, and the proposed road will run from New London through Groton, Mystic and Stonington to the Rhode Island boundary at Westerly. The company will organize soon.

SPRINGFIELD, ILL.—The Kewanee Short Line Electric Railroad, Kewanee, Ill., has been incorporated with a capital of $15,000. Incorporators and first board of directors are W. V. Eddy, F. H. Davis, H. S. White, A. P. Eddy, A. C. Scott, all of Kewanee.

GALESBURG, ILL.—Articles of incorporation have been filed of the Galesburg, Monmouth & Rock Island Railway, beginning at Galesburg, extending through Monmouth and terminating in Davenport, Ia. The capital stock is $100,000. George F. Duncan and Edward Woodman, of Portland, Me.; W. B. McKinley, J. E. Johnston and Charles Zilly, of Champaign, Ill., are the directors.

ROCKPORT, IND.—The right of way for the Evansville, Boonville & Rockport Electric Railroad has been secured from Boonville to within 6 miles of Evansville, and the right of way for the entire line between Boonville and Evansville will be secured within a short time. J. F. Britton and E. C. Henning, having charge of that work, are pushing it as rapidly as possible. Further than Boonville nothing definite has been determined upon as to the extension of the line.

SIOUX CITY, IA.—The South Sioux City, Homer & Southern Railway, a newly projected road, will run a distance of 15 miles from South Sioux City to Homer, Neb. Much of the material for the construction of the line has already been bought by the company, and work will soon begin. It is thought that eventually the line will be extended to Decatur and Tekamah.

BURLINGTON, IA.—Articles of incorporation for the Burlington Interurban Railway Company have been filed here. The capital stock is $200,000.

The officers are Carl Leopold, president; I. W. Copeland, vice-president; Charles Blaut, second vice-president; Charles Armknecht, treasurer, and J. W. Topping, secretary. The new line will be built from Burlington to Keosauqua.

TOPEKA, KAN.—The Topeka, Lawrence and Kansas City Electric Railway has applied for a charter. The capital stock is fixed at $4,000,000. Mr. T. S. Salathiel is the promoter. The road is to be 75 miles in length.

MADISONVILLE, KY.—The Madisonville Traction Company has filed articles of incorporation, with headquarters at Louisville. It is reported that a 20-mile line will be built between Madisonville and Nortonville in Hopkins County.

PLYMOUTH, MASS.—The following officers have just been elected by the Plymouth & Sandwich Street Railway Company for the coming year: Horace B. Taylor and Eben Kimball, of Boston; T. Everett Cornish, of Philadelphia; Thomas Arnold and William B. Arnold, of North Abington, and Walter L. Boyden and John H. Marshall, of Plymouth. The board has organized with H. B. Taylor as president, T. E. Cornish as vice-president, and Walter L. Boyden as secretary and treasurer.

NILES, MICH.—The South Bend-Niles Interurban Line of the South Bend & Southern Michigan Railway Company is now in operation. The South Bend & Southern Company is a consolidation of the South Bend Northern Railway Company and the South Bend & Southern Michigan Railway Company. The former extends from South Bend to the Michigan state line, and the latter extends from the Michigan state line to St. Joseph, Mich. The construction of the line between South Bend and Niles completes the first division of the proposed line between South Bend and St. Joseph, Mich.

MANKATO, MINN.—M. G. Willard and others contemplate forming a company to build an electric railway to St. Clair.

KANSAS CITY, MO.—The Metropolitan Street Railway Company has let the contract for altering the Eighth Street tunnel through the west bluff to the General Construction Company, of this city. The contract price for the work is about $200,000. The grade in the tunnel will be lowered from 8.8 per cent. to 5.3 per cent. In doing this the tunnel will be extended eastward several hundred feet. It is expected that the work of altering the tunnel will take about four months.

MARYVILLE, MO.—A certificate of incorporation has been issued to the Maryville & St. Joseph Electric Railway Company, of Maryville. The company is capitalized at $700,000. The proposed road will be 70 miles in length and will run from Parnell, in Nodaway County, to St. Joseph, in Buchanan County. The incorporators are Richard Kuchs, Richard M. Bradbury, Stephen H. Kemp, Clarence E. Bartlette, Adolphe Lippman, Charles C. Donnell, John W. Thompson, all of Maryville.

OMAHA, NEB.—It is reported the Armour Company will build a high-speed electric trolley line connecting its packing plants at Sioux City, Omaha, St. Joseph and Kansas City, and build spurs to Atchison, Kan.; Lincoln, Neb., and Des Moines, Ia. It is stated that preliminary surveys have been secretly made, and that eventually the line will be extended to the Chicago stockyards. Both freight and passenger traffic are said to be contemplated.

CAMDEN, N. J.—The General Traction Company has been incorporated with a capital stock of $1,000,000. The object is to operate electric street railways. The incorporators are W. W. Benson and Charles G. Willis, of Philadelphia, and George A. Aldrich, of Audubon.

SANTA FE, N. MEX.—At a meeting of the stockholders of the Capital Light & Power Company the following directors were elected: James G. Halapleus, Toledo; A. R. Gibson, J. P. Conner, Antoyno Winsor and H. E. Gibson, Santa Fe. The directors elected the following officers: A. R. Gibson, president; J. P. Conner, vice-president; H. E. Gibson, secretary; Antoyno Winsor, treasurer, and Jas. G. Halapleus, general manager. The company will build a large power plant on the Pecos and an electric railway between Santa Fe and Las Vegas.

SCHENECTADY, N. Y.—It is said that the Schenectady Railway Company has practically decided to extend its lines from Albany to Schodack Landing, passing through Brookview and Castleton.

NEW YORK, N. Y.—The Pennsylvania Railroad Company is building a power house for the Atlantic Avenue-Jamaica branch of the Long Island Railroad. This branch is now operated by steam power, which is to be displaced by electric power. It is stated that sooner or later many of the other short-haul lines will be operated in the same way. This, however, is a matter for future determination.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company has placed orders for about $125,000 of new material for improving city lines.

EAST LIVERPOOL, OHIO.—L. W. Healey, of the United Power Company, has surveyors at work on a route for an electric railway from Wellsville to Steubenville.

TOLEDO, OHIO.—The capital stock of the Toledo & Michigan Electric Railway is to be increased from $450,000 to $4,500,000, to extend the line from Adrian to Coldwater, a distance of 60 miles.

CLEVELAND, OHIO.—Frank DeHass Robinson, who built the cable system in Cleveland and sold out to Senator Mark Hanna, has announced that he is at the head of the Cleveland Traction Company, and that as soon as the fight between Mayor Tom L. Johnson and the Cleveland Electric Railway Company is settled he will re-enter the field and offer a straight three-cent cash fare or ten tickets for twenty-five cents. He proposes to sell his stock to the "common people."

PORTLAND, ORE.—Efforts are being made to induce the City & Suburban Railway Company to extend its Montavilla line to Fairview and Troutdale.

ASTORIA, ORE.—E. M. Ormen, an electrical engineer of Cincinnati, Ohio, has been making an examination of the country between Astoria and Seaside in the interest of the projected electric railway to connect the two towns. Local reports say he represents the Oregon Railway & Navigation Company.

DALLAS, TEX.—The Council has granted a franchise to Robert McCart, A. T. Byers, M. Sanguinett, C. S. Mitchell, Stuart Harrison and associates for the construction of a street railway to Arlington Heights.

DOYLESTOWN, PA.—Rights of way for the extension of the Philadelphia & Easton Railway's line from Tohickon Park to Bedminster, 3 miles, have been secured, and the directors expect to let the contract within a few weeks. The extension will cost about $50,000.

HAZLETON, PA.—The Hazleton, Weatherly & Mauch Chunk Railway Company has decided to begin a survey for its proposed line between Nesquehoning, Tamaqua, Broad Mountain, Hudsondale, Weatherly, Beaver Meadow and Hazleton. The route is 17 miles long. Charles Walters, of Wilkesbarre; J. M. Stauffer, of Beaver Meadow, and Ira N. Barnes, of Weatherly, are interested.

WALNUTPORT, PA.—The Heimbach Railroad Company has been incorporated to build a line fourteen miles long in Northampton County, capital stock, $140,000. Jay S. Moyer, of Bethlehem, is president of the company, and the directors are Frank Jacobs, Allentown; A. N. Brown, H. A. Thompson, John H. Fuenfstueck, Bethlehem; H. F. Weaver, S. Bethlehem; George H. Kressler, West Bethlehem.

FAIRHAVEN, WASH.—The County Commissioners have granted the Whatcom-Skagit Interurban Railway Company a franchise over a specified route in Whatcom County. The company plans to build 26 miles of road in the county.

LEGAL.

WESTERN UNION AND PENNSYLVANIA.—In the United States Circuit Court at Wilmington, Del., on Aug. 21 Judge Bradford issued an order temporarily restraining the Philadelphia, Baltimore & Washington Railroad Company, the Delaware Railroad Company and the Delaware, Maryland & Virginia Railroad Company from interfering with the property of the Western Union Telegraph Company on the right of way of these railroad companies. The order of Judge Bradford will remain in force until the question has been finally decided by the United States Supreme Court, or until the local court makes a further order.

INJURY TO CUSTOMERS FOR LIGHT.—In the suit of Lawrence and the Denver Consolidated Electric Company the Supreme Court of Colorado has decided that the complaint against an electric light company for injuries stated a good cause of action for negligence when it alleged that defendant was in the exclusive control of a plant for generation and distribution of electricity, that it supplied with electricity the residence where plaintiff lived, and that by reason of its failure to keep and maintain its plant and appurtenances in a safe condition, and to inspect them, plaintiff was, without fault or negligence on his part, seriously burned and permanently injured, by receiving a severe and terrific charge of electricity while attempting to turn on an electric light. The court also held that while a corporation furnishing electric light to others for private gain may not be regarded as an insurer, it owes its patrons the duty to protect them from injury by exercising the highest skill, most consumate care and caution, and utmost diligence and foresight in the constructable, consistent with the practical operation of its plant.

THE AUTOMOBILE.

CLEVELAND AUTOMOBILE CLUB.—The Fall race meet of the Cleveland Automobile Club will be held on September 4 and 5.

RHODE ISLAND AUTOMOBILE MEET.—The third annual race meet of the Rhode Island Automobile Club will be held at Narragansett Park, Providence, September 19.

RECEIVER FOR AUTOMOBILE COMPANY.—L. J. Hammond has been appointed receiver for the General Automobile & Manufacturing Company of Cleveland, Ohio, upon application of the W. M. Pattison Supply Company.

IMPORTED AUTOMOBILES.—The business of importing automobiles is unusually active nowadays. Recently eighteen automobiles arrived at the Appraiser's Stores in New York where there is at present a large stock of the machines. In the last three weeks thirty automobiles have been passed, with an aggregate value of about $150,000.

NEW INDUSTRIAL COMPANIES.

THE NIAGARA SAFETY TROLLEY GUARD COMPANY of Niagara Falls has been incorporated; capital $50,000. Directors: Edward McDonnell, Morris Cohn, Jr., Frederick Charmann, Niagara Falls.

THE NATIONAL ELECTRIC CONTRACTING AND CONSTRUCTING COMPANY has been incorporated at Camden, N. J., to manufacture and sell electrical appliances, etc.; capital, $100,000. Incorporators: Frederick G. Warrell, Harry Thwaite, William L. Horner and Albert E. Warrell.

THE INDIANA ELECTRICAL COMPANY, of Crawfordsville, Ind., has been incorporated, with a capital stock of $30,000, all paid up. The company succeeds to the business of the Irwin Electric Company, the latter being absorbed by the new enterprise. The present factory will be enlarged for the purpose of buying and selling electrical machinery, appliances and supplies. The company will make and market dynamos, transformers, lamps and all kinds of electrical apparatus. The officers of the new corporation are: President, W. F. Hulet; vice-president, H. W. Ornbaun; secretary, G. B. Luckett; general manager, O. C. Irwin.

PERSONAL.

MR. W. MARCONI arrived last week on the Cunarder *Lucania*, which was in wireless communication all the way over with ship and shore

MR. GEORGE BULLOCK, president of the Bullock Electric Manufacturing Company of Cincinnati, Ohio, is now in New York on a few days' visit.

MR. G. WILBUR HUBLEY, superintendent and electrical engineer of the Louisville, Ky., Lighting Company, made a brief visit to New York City and the East last week.

MR. E. W. GOLDSCHMIDT, New York district manager of the Bullock Electric Manufacturing Company, is back at his desk again after a month's absence owing to indisposition.

MR. W. J. CLARK, manager of the foreign department in Europe of the General Electric Company, has arrived in this country in time for the street railway convention at Saratoga.

MR. E. B. LE MARE, as holder of the Gartside scholarship of Owens College, Manchester, England, will pass a year in the United States in post-graduate work in electrochemistry.

SIR W. H. PREECE, who was recently reported seriously ill with pneumonia, is, we learn by cable, in better health. We hope soon to be able to announce his complete recovery.

MR. DAVID HALL has resigned his position as chief engineer of the Milwaukee Electric Company to accept a position in the engineering department of the Bullock Elec. Mfg. Company.

MR. GEORGE C. EWING has been appointed New England representative of the Cooper Hewitt Electric Company, of New York City, to handle the Hewitt mercury vapor lamp in that territory.

MR. DOUGLASS BURNETT, of the electrical engineering staff of the New York Edison Company, was married in Brooklyn, N. Y., on Saturday, August 29, to Miss Jane Elting Young. The happy pair are now on their honeymoon.

MR. HENRY C. MEYER, JR., M. E., New York, has been retained to design and superintend the construction of a central heating and lighting station to be erected at West Point, N. Y., as part of the extended improvements to be made at the United States Military Academy.

MR. F. Z. MAGUIRE, who is well known in the field of electrical finance and promotion here and abroad has been elected vice-president of the De Forest Wireless Telegraph Company. Mr. Maguire was at one time secretary to Prof. Alexander Graham Bell and was later associated with Mr. Edison.

MR. T. F. MANVILLE, president of the H. W. Johns-Manville Company, and family have returned from a two months' trip abroad, visiting London, Paris, Berlin and other places on the Continent. Mr. Manville was largely interested in numerous important tests of the efficiency of pipe-coverings conducted by the English Government, and feels confident of closing some large contracts as a result.

MR. J. S. FEARON, of Fearon, Daniel & Company, of China, arrived in New York this week from the Far East. Some substantial contracts for various electrical equipment will be placed as a result of his visit to the States. Mr. Fearon's firm purchases electrical supplies, etc., for the Shanghai Municipal Council lighting system which provides electric light in the foreign settlement of that Chinese city.

MR. H. H. ROBINSON, the active and efficient general manager of the United States Telephone Company, at Cleveland, O., has now been appointed general manager of the Illinois Telephone & Telegraph Company, of Chicago, whose automatic exchange and subway system were fully described in these pages not long ago. His resignation took effect September 1, and he assumes his new duties at once.

MR. THOMAS A. EDISON, it is stated, has been giving some attention of late to the cure of cancer caused by Röntgen-ray and radium burns. His theory is that cancers that begin on the surface can be cured by the introduction of fresh blood from a healthy subject into the blood of the person affected. Mr. Edison believes that the idea is entirely tenable and having pointed out a way he will let the surgeons and scientific physiologists work out the problem.

MR. C. T. MANNING, who is primarily interested in the American syndicate which proposes to build a 500-mile electric railway across Nicaragua, has left New York for that Central American country. Mr. Manning, who is R. G. Dun & Company's representative in Nicaragua, is understood to have completed financial arrangements which permit of the syndicate acquiring the existing Nicaraguan Government steam road, 161 miles long, which is to be electrically converted.

MR. HENRY HINE, president of the Guanajuato Electric Light & Power Company, which concern is about to start operations on the second longest power transmission plant in this hemisphere, has left New York for Colorado Springs en route for Mexico. The Guanajuato plant will begin to generate current early next month. The transmission line will exceed 100 miles in length. The voltage will be 60,000. The energy will be utilized mainly for the purpose of operating several of the mines in the Guanajuato district, one of the richest mining regions in the Southern Republic.

MR. EMILE BERLINER, of Washington, well known as the inventor of the telephone transmitter bearing his name, the gramophone, and other important inventions, announces he has devised an aeroplane which has successfully maintained itself in flight. Over thirty years ago he took up the idea of the aeroplane, and urged that by means of the compression of air in front of the slanting sails and a motor to push the machine forward it was possible to sustain weight in the air and for man to fly. Eighteen years ago he made a large model embodying his ideas, but it failed to work. Since Prof. Langley began his recent aeroplane experiments Mr. Berliner has again taken up the old study of his youth, and has been flying out on one of the suburban roads on an aeroplane built on the buzzard plan.

EDUCATIONAL.

ARTISANS ELECTRICAL INSTRUCTIONS.—The General Society of Mechanics and Tradesmen of the City of New York, 20 West 44th Street, offers free evening instruction in physics preparatory to special work in electricity, in which the principles of electricity are taught, including the laws of electric currents and electrical measurement. The school offers a very complete course in mechanical drawing.

Trade Notes.

THE COUNTRY FAIR held under the auspices of the Cortelyou Club, in Brooklyn, will be decorated with Norbitt temporary decorative sockets, as made by the Crouse-Hinds Electric Company.

CARNIVAL DECORATIONS.—At the Business Men's Carnival to be held at Paterson, N. J., the Norbitt temporary decorative sockets, of the Crouse-Hinds Company, F. M. Hawkins, New York agent, are to be freely used.

PITTSBURGH TRANSFORMER COMPANY, Pittsburgh, Pa., issues for September a very pretty little calendar, with a girl's head on it. It calls attention to its apparatus, requesting trial of it, and invites inquiry as to its merits and qualities.

REMOVAL.—The New York office of the Plunger Elevator Company on Sept. 1 moved from 156 Fifth Avenue to Room 509 Whitehall Building, No. 17 Battery Place. This move was occasioned by the demand for increased office space and by the desirability of a down-town office location.

KNIFE SWITCHES.—Pass & Seymour, Inc., have added a complete line of knife switches to their already extensive list of "P. & S." specialties. Following their established custom, they will make nothing but absolutely the best at reasonable prices. A handsome catalogue illustrates and describes the new switch.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agents for Gutmann wattmeters insist that this wattmeter catalogue is an acknowledgement reference book on meters, and that it contains valuable information of a general character that should be read by every one operating meters. This catalogue will be mailed free of expense upon request.

TESTING BUREAU EQUIPMENT.—A spectro-photometer with brace prism, a Matthews integrating photometer, a Matthews arc lamp photometer, and a special device for the photometry of shades, reflectors, etc., are among the recent additions to the photometric equipment of the laboratory of the Lamp Testing Bureau, whose temporary quarters are at No. 14 Jay Street, New York City. This increase of facilities enables the Lamp Testing Bureau to undertake a great variety of photometric determinations.

LIGHTING IN A NEW YORK CHURCH.—Simplicity, the keynote of the decorations in the Second Church of Christ, Scientist, in New York City, is obtained in a great measure by the method of illumination. The incandescent lamps being concealed in mouldings and cornices, the effect produced is both mysterious and beautiful. The auditorium has a seating capacity of 1400 and no shadows being caused by this mode of lighting, every portion of the room is thoroughly lighted with a soft glow. This church is lighted by I. P. Frink, 551 Pearl St., New York, with his system of reflectors for concealed lighting.

SELECTIVE SIGNALLING APPARATUS.—The Swedish-American Telephone Company reports that the selective signalling apparatus that it recently put on the market is meeting with universal favor. The simplicity of the device makes it doubly attractive to buyers and those interested in this class of apparatus. The complication of springs, triggers and mysteriously wound coils is obviated, insuring the user satisfactory service and the operator a low cost of maintenance. Telephone buyers and those interested are requested to communicate with this concern for full and complete information.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is preparing to enlarge its business by increasing its capital stock from $300,000 to $1,000,000. It is stated that the company will be re-organized and that a number of New York capitalists will be interested in it. Howard K. Gilman, president of the company, is to retire, but will retain an interest in the company and be a director. It is not known who is to succeed him as president. The new organization will take effect September 1. It is understood that Roger Scudder is to become an active participant in the affairs of the company. Mr. Gilman, it is said, is now organizing a construction company of which he will be president.

LAMP TESTING BUREAU.—More than two years ago the Lamp Testing Bureau, incorporated under the laws of the State of New York, began business as inspectors and testers of incandescent lamps. Its first customers were electric lighting and railway companies, manufacturers and purchasers of incandescent lamps. Its business was a success from the start and now embraces a grand total of over 10,000,000 lamps purchased by its customers and submitted by the manufacturers for inspection and test. In addition to lamp testing, the company has equipped a temporary laboratory at No. 14 Jay Street, New York City, for making electrical tests and calibrations of instruments, apparatus, materials and supplies, and has been able to a very great extent to fill the existing demands for services in this field. The growing demand for tests has taxed the present facilities of the company to such a degree that it is now found necessary to increase its equipment immediately more than one hundred per cent. To meet all the requirements a suitable building of heavy fireproof construction at 80th Street and the East River, New York City, has been secured, where its laboratory facilities will be greatly enlarged, its scope extended and its resources developed to meet any probable demands. The whole will form one of the most complete electrical laboratories that has ever offered its services for commercial testing. The company feels confident that by maintaining a skilled technical staff and assistants, together with a completely equipped laboratory, the value of its services will receive wider recognition. The company will welcome suggestions as to ways of increasing its public usefulness.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 25, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,149. APPARATUS FOR SELECTIVE ELECTRIC SIGNALING; John S. Stone, Boston, Mass. App. filed Dec. 2, 1902. A re-issue of patent 714,831.

736,672. TELEPHONE; John A. Barrett, Louis A. Falk and Herbert E. Shreeve, Boston, Mass. App. filed Dec. 8, 1902. (See page 390.)

736,928. ELECTRIC MOTOR AND GENERATOR; Arthur Le R. Bolen and George E. Krause, Indianapolis, Ind. App. filed Oct. 25, 1901. Details.

736,933. AUTOMATIC PRINTING TELEGRAPH; Charles L. Buckingham, New York, and Emil Germann, Brooklyn, N. Y. App. filed Feb. 1, 1900. The invention includes primarily a secondary relay which actuates the press magnet for all transmissions except the space transmission.

736,936. INSTRUMENT FOR TEACHING AND PRACTICE OF TELEGRAPHY; Charles E. Chinnock, Brooklyn, N. Y. App. filed April 27, 1901. The operator can turn a wheel which carries on its edge projections to actuate a circuit closer in accordance with Morse characters, the projections being grouped and a letter applied to each group.

736,942. TROLLEY POLE BASE; Albert D. Crossley, South Norwalk, Conn. App. filed March 4, 1903. An arrangement of contact plates upon the pole base.

736,950. INCANDESCENT ELECTRIC LAMP; James W. Forster, Chicago, Ill. App. filed April 17, 1901. The glass portion of the lamp is made in two parts, one of which is attached to the base and is of heavier material than the other, the latter inclosing the vacuum chamber, the object being to minimize the loss due to breakage.

736,966. ELECTRIC ARC LAMP; Haydn T. Harrison, London, Eng. App. filed June 27, 1902. The lower electrode is attached to a float resting on a body of mercury and inclosed within a solenoid.

736,975. AUTOMATIC ELECTRIC SAFETY SIGNAL; William W. Keener, Chesterfield, Ind. App. filed March 13, 1903. Details.

737,019. SELF-WINDING ELECTRIC CLOCK; Henry Rempe, Danville, Pa. App. filed Nov. 12, 1902. Details.

737,027. INSULATOR; William G. Rutledge, Brown Valley, Minn. App. filed Sept. 8, 1902. An insulator having a slotted top, the slot making a quarter turn and ending in a number of grooves, so that the insulator can be used on either a horizontal or vertical surface.

737,053. ELECTRIC RAILWAY SIGNAL; Henry A. Ammann and Albert D. Campbell, Spokane, Wash. App. filed March 9, 1903. Details of a device for attachment to the trolley wire and actuated to close a signal circuit by the passing trolley wheel.

737,072. WIRELESS TELEGRAPHY; Charles G. Burke, New York, N. Y. App. filed Sept. 21, 1901. A system for automatically transmitting and receiving in which the transmitting key is actuated through the agency of perforated tape which contains openings of uniform size variously spaced; the receiving apparatus includes a pen normally tracing a continuous line which is lifted at each impulse to divide the line up into dots and dashes corresponding with the spaces between the dots on the transmitter tape.

737,094. CONTROLLING SYSTEM FOR RAILWAY SIGNALS; George Gibbs, New York, N. Y. App. filed May 22, 1902. A supplemental device in which any of the signals can be held at danger by manually operated devices, notwithstanding that the automatic devices would ordinarily clear the signals; this is used whenever occasion requires.

737,107. ELECTRIC CIRCUIT CLOSER; Conrad Hubert, Spuyten Duyvil, N. Y. App. filed June 19, 1902. A circuit closer for bull's eye lamps in which a light pressure will close the circuit only as long as the pressure is applied, while a heavy pressure will lock the device in its closed position to hold the circuit closed indefinitely.

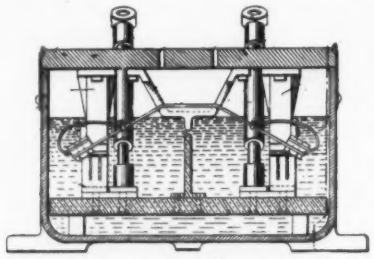
737,114. INCANDESCENT LAMP SOCKET; Owen E. Kenney, Toledo, Ohio. App. filed Dec. 31, 1902. Details.

737,162. APPARATUS FOR ELECTROPLATING SMALL METALLIC ARTICLES; John F. Shelton, Fort Worth, Texas. App. filed Sept. 16, 1901. The small articles are placed in a revolving perforated wooden cylinder.

737,170. APPARATUS FOR SELECTIVE ELECTRIC SIGNALING; John S. Stone, Cambridge, Mass. App. filed Aug. 2, 1902. A metalically-continuous elevated conductor serially connected with a plurality of closed resonance circuits each attuned to a different frequency.

737,173. LIGHTNING PROTECTOR; Jason D. Timmerman, Stone Mills, N. Y. App. filed May 14, 1903. A frame work is erected over a building and lightning rods supported upon it.

737,192. DYNAMO ELECTRIC MACHINE; Harry M. Acly, Pittsfield, Mass. App. filed Jan. 31, 1903. An arrangement of lugs and clamps whereby the coils are supported in position and can be readily removed and replaced.



737,254.—Fuse.

737,203. AUTOMATIC PRINTING TELEGRAPH; Charles L. Buckingham, N. Y. App. filed Feb. 1, 1900. An alphabet or code in which the letters are each formed by a definite number of transmitted impulses, while the figures are each formed of a different definite number, the character of the letters or figures being determined by prolonging some one or more of the impulses.

737,210. ELECTRIC STOP MECHANISM; Samuel G. Colt, Pittsfield, Mass. App. filed Sept. 23, 1901. A motor geared to a gate valve is provided with an automatic clutch which disconnects the motor when the valve is either fully closed or fully open.

737,227. ELECTRIC HEATER; William S. Hadaway, Jr., East Orange, N. J. App. filed Sept. 7, 1901. A peculiar form of flatiron having an electric heater inside in combination with a stand upon which the iron may be placed either in a position to close the circuit to the heater or leave it open.

737,237. SPEED GEAR FOR MOTORS; Albert B. Holson, Chicago, Ill. App. filed Jan. 6, 1902. The speed is varied by simply locking different concentrically disposed annular racks with the driving pinions of the motor.

737,242. TELEPHONIC APPARATUS; Miller Reese Hutchison, Upper Montclair, N. J. App. filed April 11, 1902. (See page 390.)

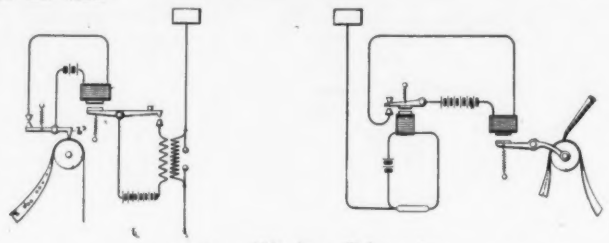
737,253. ELECTRIC MOTOR; Harry Lindenberger, St. Louis, Mo. App. filed July 26, 1902. An armature ring has closed-in heads from which project hubs, one of which serves as a pulley and the other as a carrier for commutator segments.

737,254. FUSE; William J. Lloyd, Pittsfield, Mass. App. filed Sept. 9, 1902. The terminals of a fusible strip are immersed in oil only the middle portion being exposed.

737,255. ELECTRICAL MEASURING INSTRUMENT; William J. Lloyd, Pittsfield, Mass. App. filed Feb. 10, 1903. The sensitive coil is mounted in a spherical chamber formed by the windings of a fixed coil which affords an intense and uniform field for all positions of the movable coil.

737,265. ELECTRIC BRAKE; Frank C. Newell, Wilkinsburg, Pa. App. filed Dec. 31, 1902. An automatic reversing switch which will always set up the proper combination of circuits for braking when the car is moving in either direction.

737,280. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed Feb. 19, 1900. The indicator usually fixed to the outside of the tube containing the fuse is arranged partially inside and partially outside of the wall of the tube.



737,072.—Wireless Telegraphy.

737,281. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed May 23, 1901. The indicator wire is arranged wholly inside of the tube, but a cord attached to it extends through an opening in the wall of the tube where it can be grasped or observed.

737,282. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed Jan. 13, 1902. A permanent casing serving as a holder for a fuse tube and adapted to be used with many different tubes.

737,283. FUSE BLOCK; Joseph Sachs, Hartford, Conn. App. filed May 6, 1902. The block contains grooves for main wires and clips to receive fuse tubes which will be held at right angles to the wires and in a different plane.

737,284. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed Sept. 29, 1902. The fuse tube is divided into a number of chambers through which the fusible strip is led in a zig-zag direction, thus making a short tube accommodate a long strip.

737,285. BATTERY ELEMENT; Charles B. Schoenmehl, Waterbury, Conn., App. filed May 19, 1902. A battery element, comprising a solidified and hardened flat depolarized plate, broadest through its top edge.

737,286. GALVANIC BATTERY; Charles B. Schoenmehl, Waterbury, Conn. App. filed May 1, 1903. A battery element comprising an annular solidified copper oxide depolarizer.

737,303. ELECTRICAL MEASURING INSTRUMENT; Thomas W. Varley, New York, N. Y. App. filed Dec. 26, 1902. The casing is pivotally mounted so that if the needle shows any deflection due to external magnetism, the casing can be shifted to compensate for it.

737,310. INCANDESCENT LAMP SOCKET; Joseph L. Yost and Owen E. Kenney, Toledo, Ohio. App. filed June 12, 1903. Details.

737,315. ELECTRIC ARC LAMP; Malcolm H. Baker, East Liberty, Pa. App. filed June 28, 1902. An improvement in the Bremer lamp in which an electro-magnet is used to withdraw a striker or igniter from the electrodes at the moment the current is turned on, the operation of the magnet being retarded to prevent a repetition of the action before the arc is actually established.

737,342. ELECTRIC ARC LAMP; Tito L. Carbone, Grunewald, Berlin, Ger. App. filed Dec. 30, 1902. The arc is surrounded by an iron ring placed in a magnetic circuit which thereby steadies the light.

737,343. ELECTRIC ARC LAMP; Tito L. Carbone, Grunewald, Berlin, Ger. App. filed Feb. 7, 1903. Details.

737,345. TELEPHONE TEST INSTRUMENT; Henry George Chalkey, New York, N. Y. App. filed June 19, 1902. (See page 390.)

737,349. SNAP SWITCH OPERATING MECHANISM; Charles A. Clark, Hartford, Conn. App. filed July 23, 1902. Details.

737,353. CONNECTING HOOK FOR ELECTROTYPERS; Jesse W. Cornelius and John Niemer, Cincinnati, Ohio. App. filed July 5, 1902. The bottom part of the hook switch which supports the plate in the bath is encased in lead or an alloy of lead, tin and antimony, to prevent its being attacked by the solution.

737,359. ELECTRIC ADVERTISING DEVICE; Jonathan C. Carrah and Russell A. Willson, Helena, Mont. App. filed June 23, 1902. The lamps are mounted on the spokes of a wheel and rotated by a motor while the circuits are variously operated.

737,368. ELECTRIC SAFETY FUSE OR CUT OUT; Louis W. Downes, Providence, R. I. App. filed June 2, 1900. The indicator wire on the outside of the tubes has attached to it a composition or a label which changes its appearance and gives an unmistakable indication of the destruction of the main fuse.

737,369. ELECTRIC FUSE OR CUT OUT; Louis W. Downes, Providence, R. I. App. filed Feb. 2, 1903. A modification of the preceding patent.

737,460. MEANS FOR STARTING ELECTROLYTIC OR NERNST LAMPS; Eustace Oxley, Brooklyn, N. Y. App. filed July 2, 1901. The circuit in which the heaters of a number of lamps are connected, is closed by a hand switch which is thereafter opened by a mechanical device after the lapse of a certain interval sufficiently long to bring the burners to a conductive condition.

737,491. REEL ATTACHMENT FOR MINE LOCOMOTIVES; Kenneth Rushton, Philadelphia, Pa. App. filed May 28, 1902. A friction gear connects the reel with the axle and can be thrown in when desired to reel up the cable carried by the locomotive.

737,553. ELECTRIC MOTOR; August K. Braun, New York, N. Y. App. filed July 3, 1903. Details.

737,554. ELECTROLYTIC APPARATUS; Linus P. Burrows, Washington, D. C. App. filed Jan. 22, 1902. The apparatus consists of a dissolving vessel, containing the anode, one or several filters, and a depositing vessel, containing the cathode. A stream of liquid is passed from the dissolving vessel into the filter and from the filter into the depositing vessel.